UNITED STATES NAVAL INSTITUTE PROCEEDINGS

Vol. 55 JULY, 1929 No. 317

Contents

The British Assault on the German Bases Ostend and Zeebrugge.—Schultz - - - - - - - - - - - - - 573

Form Suggested for the Line of Position.—Weems - - - - - 586

The Naval Hero of Korea.—Searles - - - - - - - - - 589

Postgraduate Instruction.—Granum - - - - - - - - - 595

Special Characteristics of the "Ersatz Preussen."—Dinger - - - - 602

Present Situation in Regard to Diesel Engines for Capital Ships.—Procter - - - - - - - - - - - - - - 605

Discussions - - - - - - - - - - - - - 621

Professional Notes - - - - - - - - - - - - 627

Notes on International Affairs - - - - - - - - - - 646

Book Reviews - - - - - - - - - - - - - 651

Secretary's Notes - - - - - - - - - - - - 657

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Contents

1929
Whole No. 337

THE BRITISH ASSAULT ON THE GERMAN BASES OSTEND AND ZEEBRUGGE.. 573
By Captain Karl Schultz, German Navy (Retired)

FORM SUGGESTED FOR THE LINE OF POSITION..... 586
By Lieutenant Commander P. V. H. Weems, U. S. Navy

THE NAVAL HERO OF KOREA..... 589
By Lieutenant Commander P. J. Searles, U. S. Navy

POSTGRADUATE INSTRUCTION..... 595
By Lieutenant A. M. Granum, U. S. Navy

SPECIAL CHARACTERISTICS OF THE "ERSATZ PREUSSEN"..... 602
By Captain H. C. Dinger, U. S. Navy

THE PRESENT SITUATION IN REGARD TO DIESEL ENGINES FOR CAPITAL SHIPS 605
By Captain A. M. Procter, U. S. Navy (Retired)

DISCUSSIONS 621

PROFESSIONAL NOTES 627

NOTES ON INTERNATIONAL AFFAIRS 646

BOOK REVIEWS 651

SECRETARY'S NOTES 657

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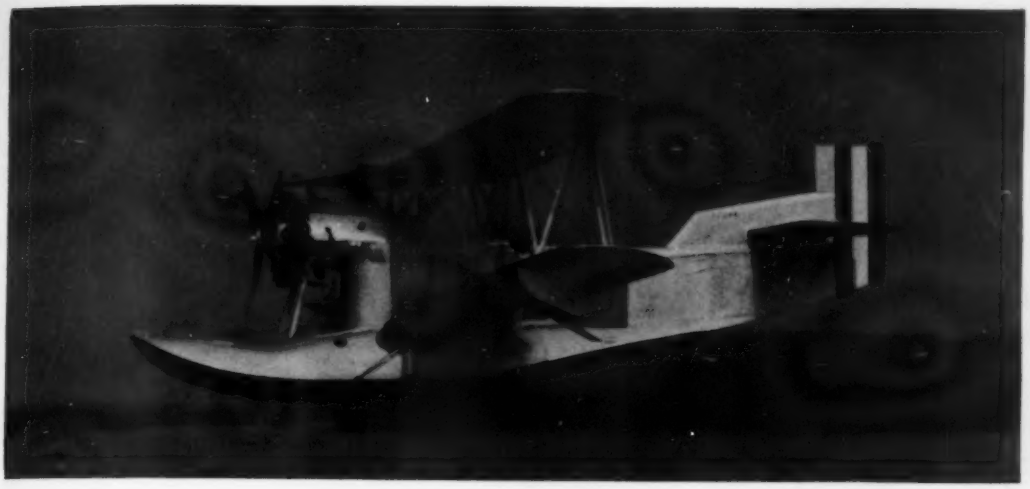

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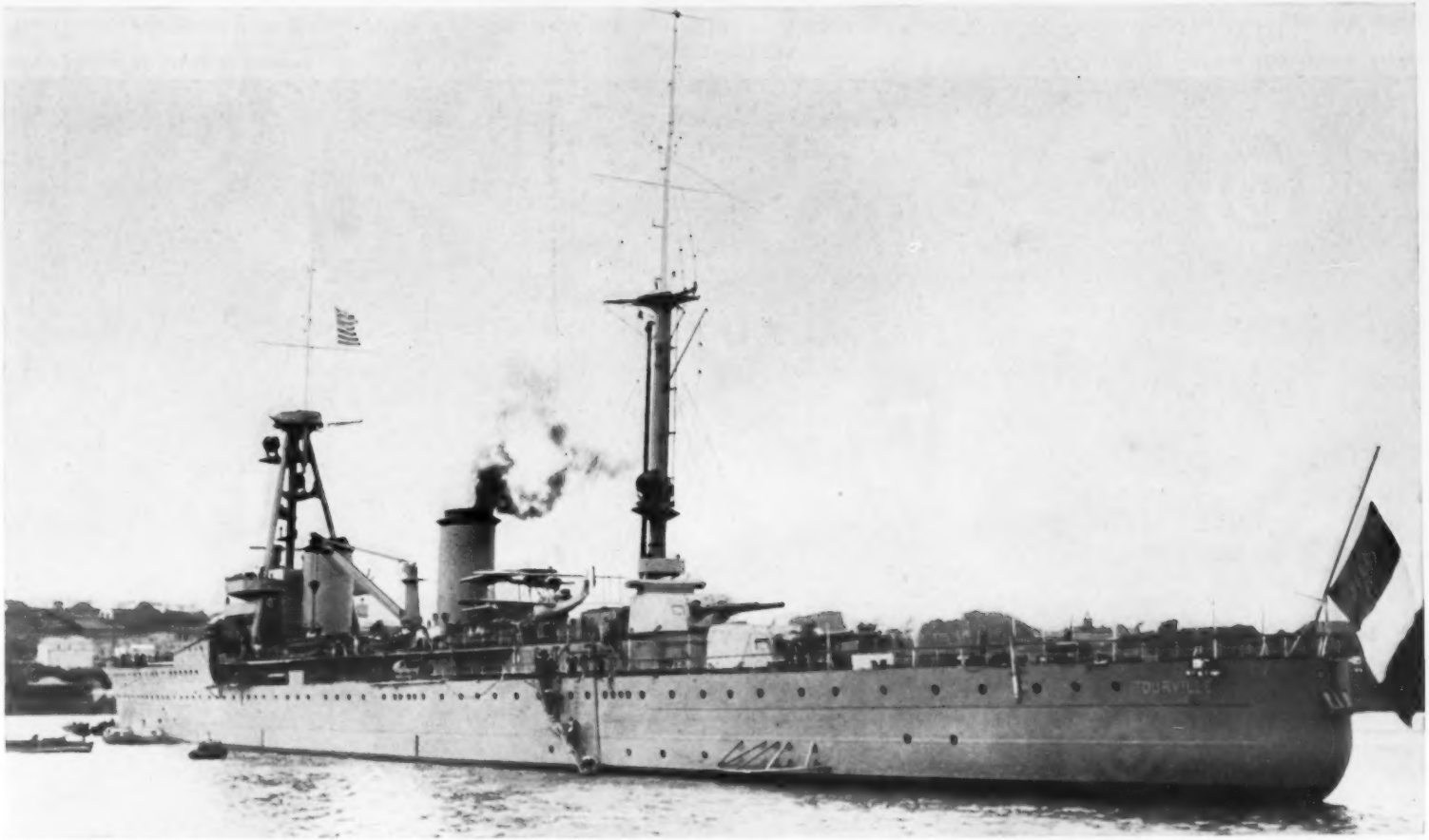
WINDJAMMERS

The *Torrens*, well known in the passenger trade of the eighties and early nineties between England and Australia. Joseph Conrad served on this ship as chief officer for one voyage.

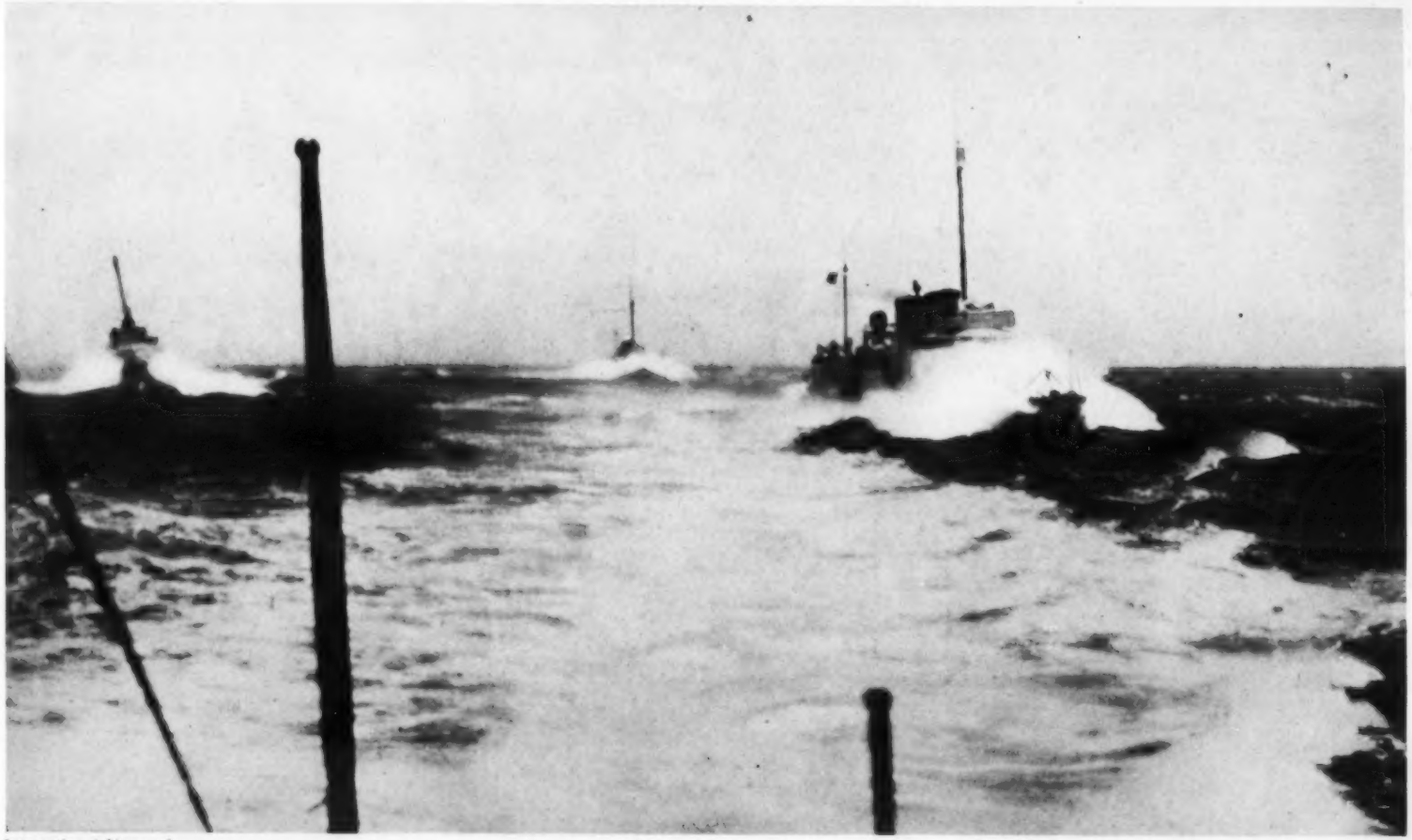


International Newsreel

THE CRUISER *TOURVILLE*

The French "Washington Conference" type cruiser used to carry the remains of our late ambassador from France to the United States.

from France to the United States.



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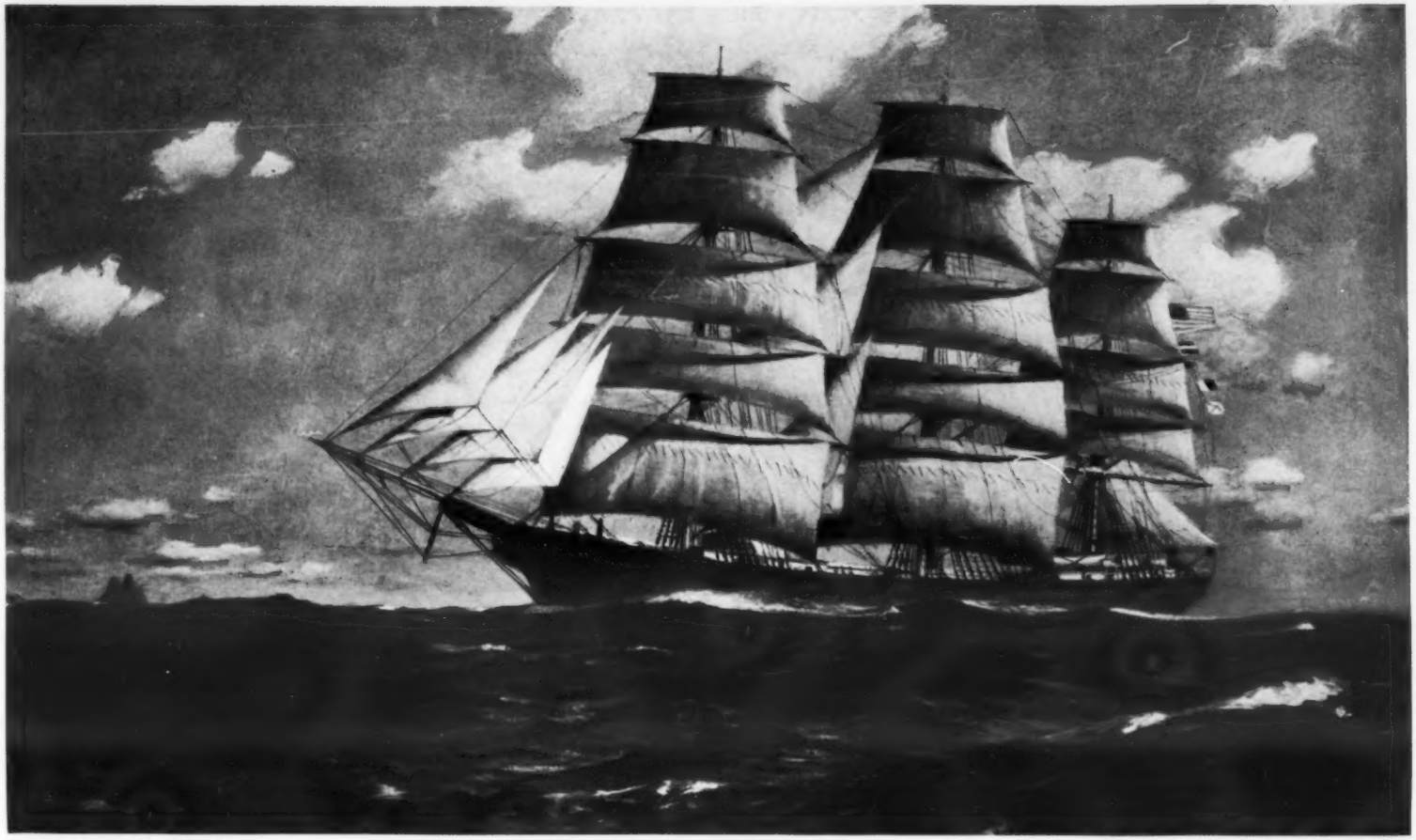
HEAVY WEATHER IN THE ATLANTIC
Destroyers battling their way through heavy seas.



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THE *ZOUAVE*

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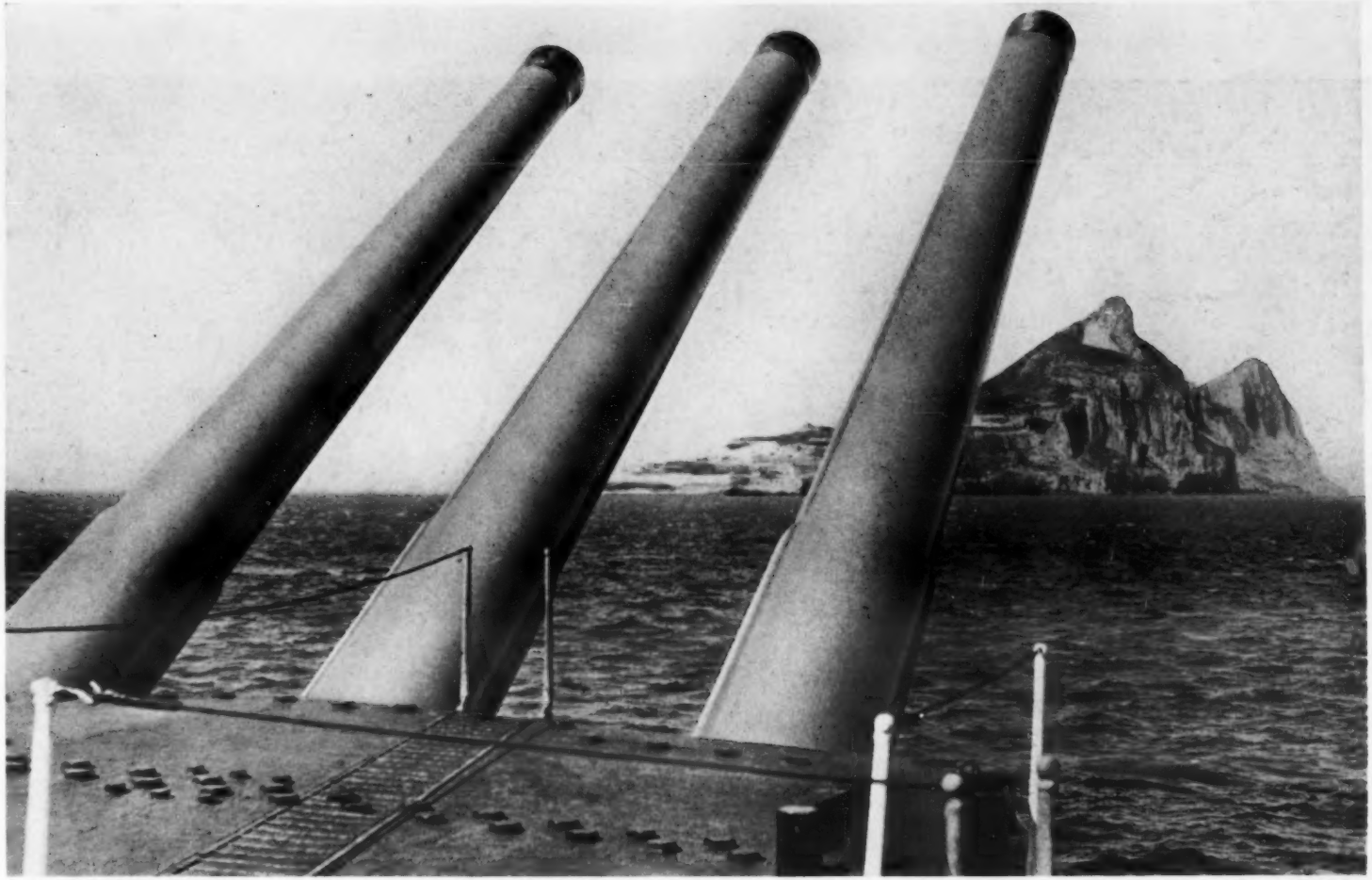
SHIPS OF THE MIDSHIPMEN PRACTICE SQUADRON AT SEA



Pacific and Atlantic Photos

THE "ROCK"

An unusual view of Gibraltar taken from H. M. S. *Nelson.* The midshipmen will visit Gibraltar on the cruise this summer.

An unusual view of Gibraltar taken from H. M. S. *Nelson*. The midshipmen will visit Gibraltar on the cruise this summer.

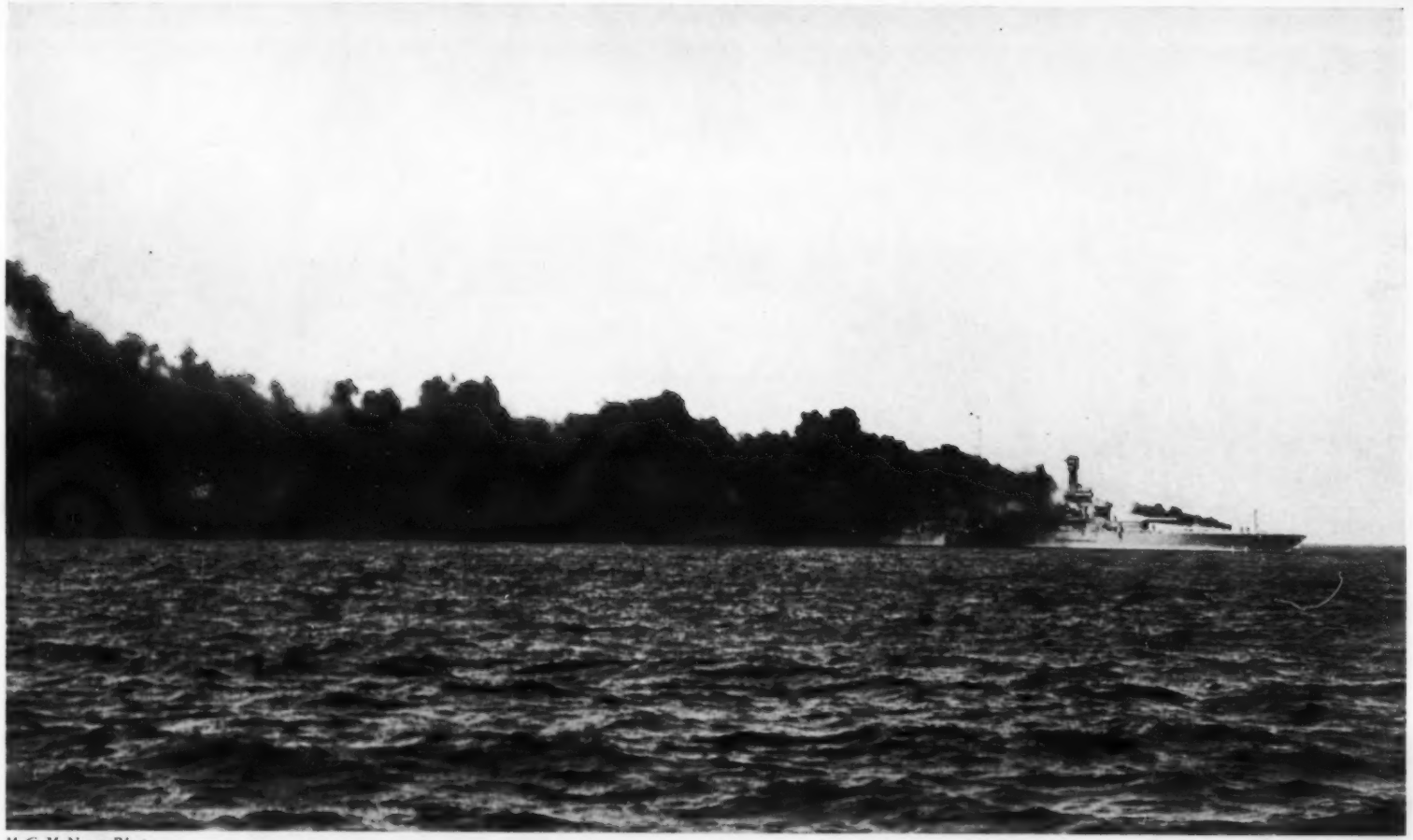
Pacific and Atlantic Photos

H. M. S. *RODNEY*
A gun-port view of Great Britain's mightiest dreadnought.

Pacific and Atlantic Photos

THE FLEET FLAG TAKES ONE OVER THE BOW
U. S. S. *Texas* in maneuvers off San Pedro.

U. S. S. *Texas* in maneuvers off San Pedro.



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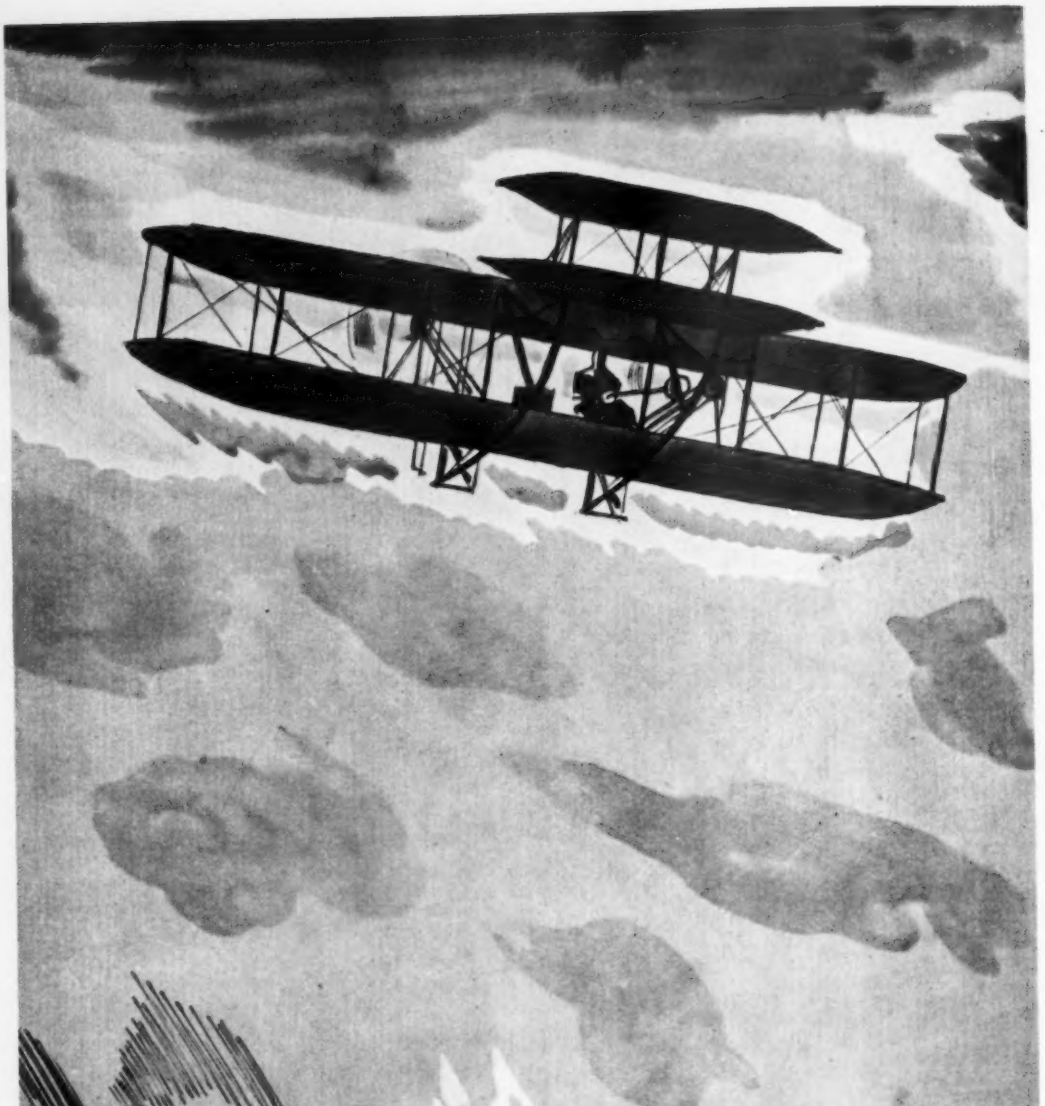
U. S. S. *CALIFORNIA*
Using smoke for defensive purposes during the winter maneuvers at Panama.

International Newsreel

THE FLEET'S IN



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The Wright Brothers' "Strange Contraption" Rises at Kitty Hawk, 1903

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Vol. No. 55, No. 7 JULY, 1929 *Whole No. 317*

The British Assault *on the* German Bases Ostend *and* Zeebrugge

By CAPTAIN KARL SCHULTZ, *German Navy (Retired)*
Prepared from the documents of the Naval Archives

THE British and Belgian press have glorified the British assaults on Zeebrugge and Ostend in 1918 with astonishing vanity, departing far from the historical facts as to the effect on the German submarine warfare.

During the war, these "Reports of Victory," erroneously announcing the complete blocking of both submarine bases on the coast of Flanders, could be regarded as good propaganda. They not only justified the unusually heavy losses sustained in these undertakings but served also to quiet the fears of the British public as to the submarine danger from the nearby shores, and to raise the morale of the great, idle fleet at Scapa Flow from which volunteers had taken part in the assaults. If we can admit ungrudgingly that these assaults were carried out smartly and cold-bloodedly by a selected crew, then England today must also admit that the defenders beat off all the assaults, especially the assault on the Mole of Zeebrugge, with equal heroism, equal doggedness and cold-bloodedness.

In the history of the German Navy, the brave defense of the Zeebrugge Mole will remain a page of glory and a shining example of the determination of a small, courageous band of men, who, in the darkness of night and in the fog, drove a greatly superior enemy delivering a surprise attack back on his ship, without permitting him to accomplish his mission or to do any damage on the mole.

For everyone who has read the history of the Great War, it is a hardly explainable fact that in the period 1914 to April, 1918, except for a number of long-range bombardments of the coast by British monitors, which were nearly always stopped as soon as there was a return fire from the German shore batteries, and except for the laying of mines and obstructions at great distances offshore, there was not a single offensive operation from the sea against any part of the Belgian coast.

Although the British Admiralty must have been fully aware of the operations of the German submarines and torpedo boats from the Belgian coast bases against the steamer routes to the Thames, and the transport routes to Dunkirk, Calais, and Bologne, they permitted these years, favorable for an assault, to pass unused and devoted themselves to the development of plans for major landing operations. The German Marine Corps, which had occupied the Flanders coast, as defense of the flank of the West Front and German sea coast, had sufficient time to fortify the entire coast line from the mouth of the Yser to the Holland boundary defensively with all manner of modern fortifications, equipped with numer-

ous long-range batteries, and had available troops prepared to repulse any large surprise landing operation.

It was scarcely possible that single ships, at night and in fog, would be able to pass the limits of range of the defense batteries, when our own ships required channels swept clear of mines.

The objective of forcing an entrance, in the face of the harbor-defense batteries, in order to block the harbors against passage by torpedo craft and submarines, is difficult to attain, and in the late war it was nowhere attained.

Admiral Sir R. Bacon, who commanded the naval forces at Dover, describes in his book, *The Dover Patrol*, plans for the large British landing operations on the Flanders coast which, unfortunately, were not carried out.

Whether the reasons given by the British are correct, or whether the disappointment over their misfortunes at Antwerp and Gallipoli and the recognition of the ever-increasing strength of the Germans on the Flanders coast became so great that the carefully prepared plans of offensive operations, especially the second landing operation at Middlekirk, were forced upon them, remains a moot question.

Because of their importance in the history of the war, it seems to me necessary to give a brief résumé of these plans for landing operations.

The first proposal was worked out in 1915 and involved a surprise landing of 10,000 men in the wake of artificial fog in the harbor of Ostend; doubtless a very bold and daring plan. The object was to overcome the German coast-defense troops west of Ostend by a simultaneous attack with the French troops located between Nieuport and the mouth of the Yser, and thus to occupy the harbor of Ostend and the entire coast west of Ostend to the Yser. The right wing of the German West Front would have been forced back to the east of Ostend. According to British statements, this plan was abandoned in the spring of 1916 after the completion of the Kaiser Wilhelm II Battery at Knocke, a battery of four 30.5-cm., 50-caliber, C/08 guns, whose range included Ostend.

In the beginning of 1917 a second plan of Admiral Bacon's which contemplated a large landing operation on the coast in the Middlekirk-Westend area, received the approval of the British Admiralty and the British-French headquarters. This landing operation was to be a distinctly British undertaking and was to be conducted in the closest coöperation with the great British land assault on the Ypres front in 1917. In order to insure complete coöperation with the British landing force, the French troops between Nieuport and the mouth of the Yser were relieved by British troops. The bringing up of a large number of heavy batteries and, as shown by our aërial photographs, the further extension of the railroads, of supply depots, of roads, and of troop billeting areas, showed us that all preparations were being made for a major offensive operation from Nieuport to the mouth of the Yser. These easily recognized preparations caused the German High Command, at the suggestion of the Marine Corps commander, to augment the marine forces with strong artillery forces, and to permit the marine infantry and bluejacket regiments to capture the extraordinarily important British bridgehead east of the Yser. Thus, the British position for an attack across the Yser to support the proposed landing operation at Middlekirk was useless. In the subsequent month of heavy fighting for the recapture of this important bridgehead at the mouth of the Yser, the British were unsuccessful. Undoubtedly, the loss of this excellent base for landing operations, along with the collapse of the British assault at Ypres, had much to do with the abandoning of the major landing operation planned for October, 1917. The British High Command planned the landing operation to take place simultaneously with the capture of Roulers and the threat against Thourout, an objective that was not attained.

Upon approval of these plans for the landing operations, three large pontoons, 550 feet long, 30 feet wide, and 18 inches in draft, with a carrying capacity of about 2,500 tons, were constructed for the landing. These pontoons were to accommodate the entire landing force consisting of 750 officers, 13,750 men, 3 tanks, 12 guns and all accessories. Each towed by two monitors, these pontoons were to be grounded at three adjacent positions on the flat shore at high water, the whole landing operation to be covered by artificial fog at dawn. The points of landing were decided upon in ad-

vance: the eastern edge of Middlekirk, at the single house between Middlekirk and Westend (Krokodil Battery) and the western edge of Westend. The preparatory tests and rehearsals of towing and landing with the completed pontoons began in the greatest secrecy in March, 1917, in the Swinn Channel at the mouth of the Thames. At the same time, aërial photographs of the flat coast at the Middlekirk landing places were taken and compared with the charts and tide tables of Ostend and Nieuport, for a period of a month, and the exact tidal conditions and water lines of the approaches and landing places were established. As Admiral Sir R. Bacon stated, all necessary preparations for such a large undertaking were tested out with the greatest care. The following were available for the expedition: the monitors *General Wolfe, General Crawford, Lord Clive* (flagship), *Sir John Moore, Prince Eugene, Prince Rupert,* for towing; the monitors *Sault, Erebus,* and *Terror* to engage the shore batteries of Ostend; and a number of motor boats and escort vessels. The entire fleet and landing force of the expedition were held in a continual state of readiness from the completion of the preparations until the end of October, 1917. This plan was abandoned after the major British offensive of Ypres was repulsed and the attempt to take Roulers failed.

French troops relieved the British at the mouth of the Yser and the landing force was sent elsewhere on the British front. The British seem to have abandoned the last hope of occupying the Belgian coast during the war. The possibility of the harbors of Ostend and Zeebrugge being useful to the British for war purposes faded from consideration. Since subsequent efforts to destroy the locks of Zeebrugge through bombardment by monitors and bombing planes proved unsuccessful, consideration was given to efforts to block the harbors by sinking ships in the channels.

This closely related plan, anticipated by the German defending forces throughout the long years of the war, can also be traced back to its inception in 1915 by Admiral Bacon, and was set aside by the British Admiralty until, on April 23, 1918, at Ostend and Zeebrugge, and on May 10 at Ostend, it was attempted with great loss of men and materials.

It must first be pointed out that Brugge, the main base of the German submarines and torpedo vessels in Flanders, had two distinctly independent outlets to the sea through the well-designed Belgian canal system. The shorter and deeper one led from Brugge to Zeebrugge; the longer and somewhat shallower one, to Ostend (see Figure

FIGURE 1

1). After the Ostend canal had been brought to sufficient depth for submarines and torpedo vessels by damming, it was used by all submarines and torpedo vessels when conditions and the needs of the Navy made it desirable. If departure from either of the two harbors proved desirable, the transfer of all torpedo vessels and submarines from one harbor to the other was possible. The British could accomplish their aim to bottle up the submarine traffic from the Flanders coast only by completely blocking both harbors. It must have been clear to the British Admiralty during the war how far short of their aims their efforts fell. But, because of the inactivity of the Grand Fleet, and of the retreat on the West Front, England had urgent need of a favorable war bulletin and used this single offensive operation against the harbors of the Flanders coast as material for war propaganda, without regard for facts.

On the night of April 11-12, 1918, several British monitors bombarded the Ostend shore batteries with about sixty heavy-

caliber shots, while enemy motor boats laid an artificial fog bank along the coast to make observing by our lookouts difficult. At the same time our coast batteries were bombarded by the enemy land batteries west of the Yser, and the harbor and locks of Zeebrugge were bombarded with aircraft bombs and were illuminated to daylight brightness by parachutes equipped with star shells. It was the first unsuccessful attack by the British on the two harbors. On this night, luck delivered into our hands a British motor boat which had been launched outside of the entrance to the harbor and had run aground. The plans of operation found in this boat caused the commander of the Marine Corps, on April 12, 1918, to order the whole coast into constant state of readiness, into war watches which provided for certain and rapid calling of all batteries of the coast to battle stations. On April 14, the batteries east of Ostend were bombarded by enemy land batteries with several shots and, in addition, newly laid British buoys found in the outer approaches to the harbor indicated further enemy plans of assault. All of these indications as well as the unfavorable condition of the British land forces on the West Front, pointed to a major operation against the coast in the immediate future. Thus, the night of April 22-23 drew nearer and several days of stormy weather followed by a falling wind, together with a favorable high water at 0045, produced favorable conditions for an assault.

The assault and attempt to block the harbors did not come as a surprise, except as to the method of procedure, and it became a test of resolution between the attackers and the mole defense forces of Zeebrugge, who conducted the defense so brilliantly.

The long years of war experience of the coast-defense forces had established that, with restricted radius of visibility which reduced the effectiveness of lookouts, torpedo boat patrols off the approaches to the harbors had no value, and that on the contrary, their presence off the entrance was not advisable because of their exposure to, and the restriction of, the fire of our own batteries. Because of the weather all patrol craft were ordered to remain in the harbor on this night as well. The large number of speedy, heavily armed British destroyers taking part in the assault made this precaution a proper one from the standpoint of humanity as well, because the presence of lookout vessels at the harbor approaches for scouting and communication could only have resulted in their loss without having been an advantage to the defense. The aircraft scouting on the day before was also without results on account of the reduced visibility.

When, at 0015, bombardment of the coast batteries east and west of Ostend with major-caliber guns commenced from seaward and from the Yser front, and a little later, bombardment of Zeebrugge and Dünbergen from seaward also commenced, the alarm was sent to all of the coast defenses and immediately the offshore waters were illuminated with star shells and searchlight beams. The atmospheric conditions, the low hanging clouds, the light onshore breeze and mist, gave very poor visibility for the time being, and even this visibility vanished with the closing in of the artificial fog bank from seaward.

The bombardment and artificial fog predicted with certainty that a major night attack on the coast was in progress by the enemy.

THE ATTEMPT TO BLOCK THE HARBOR OF OSTEND ON APRIL 23, 1918

Off Ostend, in the sector west to northwest, six bombarding units (monitors) were sighted at a range of fifteen to eighteen kilometers, aided by the enemy land batteries beyond the Yser. The first shots caused the immediate call to battle stations of the second bluejacket artillery regiment of the coast defenses of Ostend. The heavy coast batteries Preussen, Tirpitz, and Deutschland, aided by the sound-ranging parties which could occasionally make out the flashes from the monitors, took them under fire, while the heavier batteries located at the Yser took the enemy land batteries under fire. The long-range artillery battle began at 0016 and lasted until 0205. In spite of the enemy's ammunition expenditure, the bombardment was without effect because the occasional hits within the defense battery areas caused no damage. Free use of star shells combined with the beams of all searchlights illuminated enemy units from time to time and made it possible for the lighter batteries of the Ostend coast artillery to take the enemy under fire in spite

of the artificial fog which enveloped the sea, the harbor, and the coast.

The two British blocking ships approached the coast behind the artificial fog bank, escorted by motor boats, torpedo-boat destroyers, and other escorting vessels. At 0045 several larger ships were sighted making for the harbor entrance, firing as they approached. In the fog bank, their momentary appearance and disappearance made their approach a vague picture. It seemed as if several of these ships, apparently destroyers, turned away to the westward in the face of the fire of the coast batteries, while two larger ships proceeded on an easterly course. These latter grounded side by side about five hundred meters eastward of the harbor entrance, and under the heavy fire of the shore batteries were abandoned by their crews. They were the old cruisers *Brilliant* and *Sirius* which, in preparation for the blocking of the entrance to the harbor of Ostend, had been partly filled with cement and had been equipped with arrangements for blowing them up. These old cruisers, failing in their mission, badly shot up, thus found their graves off the coast. The enemy attempt to block the harbor was a failure. The first attempt to block the harbor of Ostend was repulsed with losses on our side amounting to two dead and two wounded and very slight property damage, while the enemy left his two well-prepared cruisers lying grounded on the coast, and probably sustained severe losses in the numerous vessels taking part in the operation. After the guns and ammunition and such material as could be used had been removed from the grounded cruisers, their wrecks remained lying on the coast.

The Attempt to Block the Harbor of Zeebrugge on April 23, 1918

Somewhat later than at Ostend, at 0030 on April 23, 1918, the long-range bombardment of Zeebrugge by two monitors, the *Erebus* and the *Terror*, began, and thereby alarmed the defense batteries of the first bluejacket artillery regiment. The first shots of the enemy fell in the vicinity of the harbor but subsequent ones fell in the area behind the Heyst locks, Heyst and Dünbergen, far from any military objective, and continued to fall in this area throughout the bombardment from 0100 until 0245. The bombardment may have been intended to keep down the fire of the coast-defense batteries east of Zeebrugge, beyond which the shells landed. After the alarm had been given, the smaller batteries illuminated the offshore area, especially the approaches to the harbor of Zeebrugge. The artificial fog bank which soon drifted in was so dense that rarely was a target visible sufficiently to be taken under direct fire by the coast-defense batteries, and their defensive operation was confined to laying a barrage and firing star shells. The heavy batteries, Kaiser Wilhelm II, Schleswig Holstein, and Freya, by means of sound-ranging, took the two monitors under very slow and intermittent fire, because the flashes from the monitors could barely be seen at long intervals until they broke off the bombardment at 0245, having done no damage.

The Repulse of the Attempt of the British Cruiser *Vindictive* to Land on Zeebrugge Mole

At that time, the only artillery defense installation on the Zeebrugge Mole was on the extreme eastern end on the eight-meter high runway erected just inside of the lighthouse tower, consisting of three 10.5-cm. guns and two 8.8-cm. guns, and inboard of this battery, an antiaircraft battery of two 3.7 machine guns (see Figure 2). Ever since the occupation of Zeebrugge in 1914, Lieutenant of Reserves Schütte of the bluejacket artillery had had command of the Mole Battery. Especial merit and glory is due the leadership and work of this battery on this night. At 0030 sounds of motors at sea coming from a northeasterly direction were heard by the mole batteries. Thereupon several star shells were fired but nothing unusual was sighted. Then a fog bank, soon recognized as artificial fog, was seen approaching at about 2,000 meters. Simultaneously the first heavy salvos from seaward struck in the vicinity of the harbor. The battery commander at once gave the alarm to his batteries and at the same time to the harbor batteries for "mole defense." While Battery Württemberg fired star shells, the Mole Battery scattered six salvos in the direction of the motor noises in the fog. At 0050 the commander of the Mole Battery discerned a larger vessel, range about 2,000 meters, heading westward for the mole head, and immediately opened fire on her with the three 10.5-cm. guns, while both 8.8

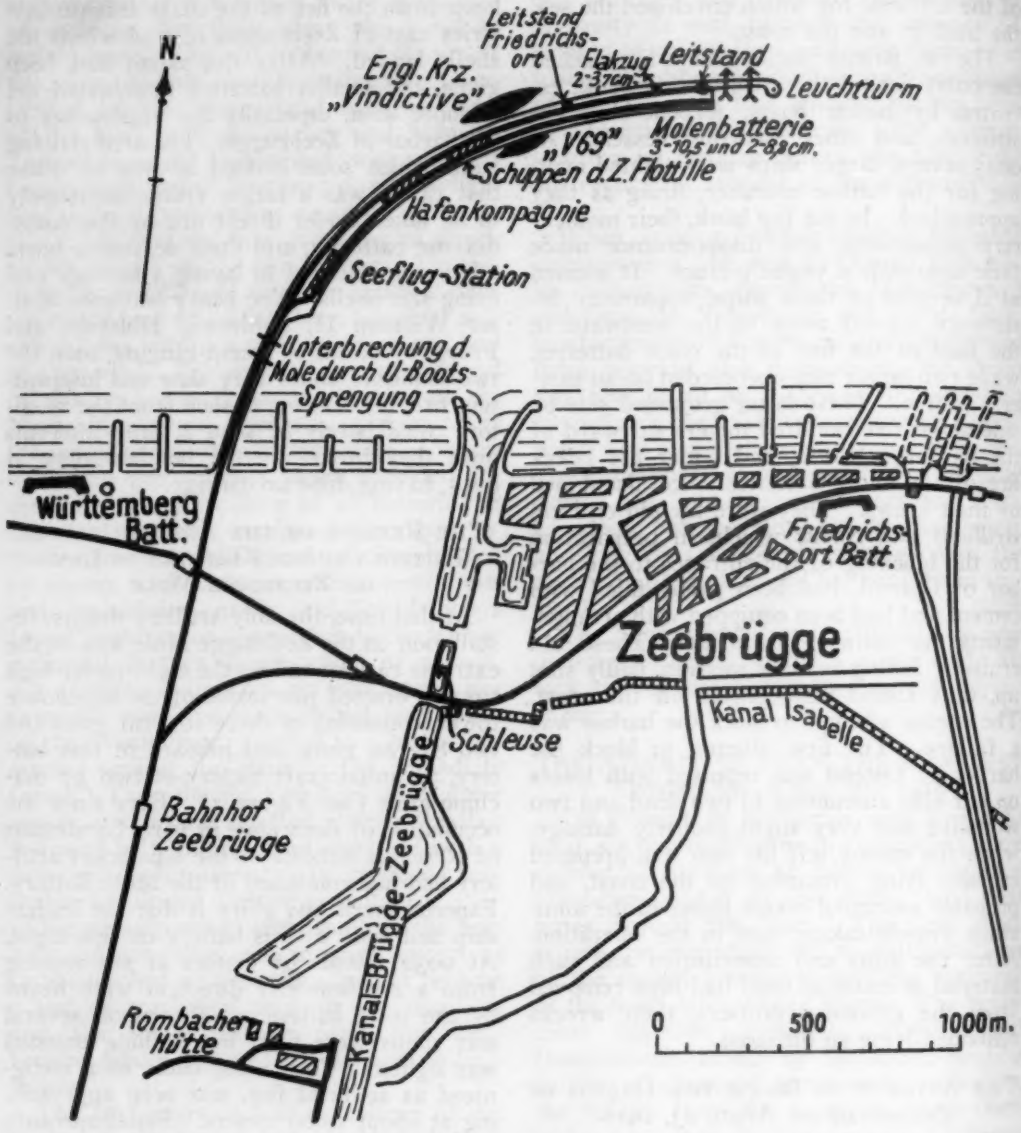


FIGURE 2

guns illuminated the target with star shells. The vessel, the British cruiser *Vindictive*, at first supposed to be intended for blocking the harbor entrance, changed course in the fire of the battery for the outer side of the mole and passed the battery at a range of about five hundred meters. Numerous hits in the hull, on deck, and superstructure were observed and seen to cause great commotion and heavy losses among the massed landing force. Both leaders of the landing force, Captain Halahan, R.N., and Colonel Elliott and a number of leading officers, fell under this fire. Then twelve of the fourteen gangplanks carried by the cruiser for the landing operation were shot up and thereby the necessary rapid debarkation at numerous points of the four companies of Royal Marines (Marine Infantry), together with the bluejacket landing force, was made impossible when the cruiser came alongside of the mole. After the *Vindictive* had passed the

battery and had reached the dead angle of the battery caused by the curve of the mole to the eastward, she was lost to view in the fog. (See Fig. 2.) The two 3.7 machine guns of the antiaircraft battery, commanded by Chief Gunner's Mate Scheidt, fired on the *Vindictive* as she passed and were able to keep the parts of her appearing over the top of the mole under effective fire, silencing the enemy machine guns which swept the mole from their position on the high board face of the mole, just west of the bridge and fighting top. About 0100 the *Vindictive,* assisted by the tugs *Iris* and *Daffodil,* on which a part of the landing force was embarked, made fast to the outboard face of the mole, just west of the control station for Battery Friedrichsort, rolling in the heavy swell. The tug *Iris* then attempted to secure alongside of the mole a little westward of the *Vindictive.* A number of men from the ship jumped on the mole, apparently to secure the lines, but were shot down by the members of the Harbor Company, so that the tug had to lie off. Lieutenant of Reserves Zimmerman, of bluejacket artillery, was controlling the fire of Battery Friedrichsort and was sending ranges, bearings, and information of the debarkation hidden from the battery by the fog, to Gunner Westphal of the Mole Battery, and to the torpedo-boat destroyers in the harbor. Lieutenant Benecke, commanding the torpedo-boat destroyer *V-69* lying at the wharf on the inshore side of the mole, assisted by Midshipman Klintzsch, cleared the only gun on board whose fire on the *Vindictive* was not blanketed by sheds, and opened fire on the gangplanks, the bridge, and the mast of the *Vindictive.* The crews of the torpedo boats lying in the harbor, which were required to be sent to the mole dugouts on the alarm of an air attack, were assembled and took part in the fight with small arms and hand weapons. The commander of the Mole Battery had assembled the previously designated shock troops of reserve personnel consisting of three mates and twenty men and had sent them under Lieutenant of Reserves d. M. A. Rodewald to the flank defense stations of the battery in accordance with prearranged plans. At the same time, the personnel of the control station of Battery Friedrichsort, which lay on the upper runway of the mole immediately eastward of the machine-gun battery, arrived. The men were so distributed that the upper runway of the mole and the top of the mole could be kept under rifle fire. Lieutenant Zimmerman was obliged to abandon the control station for Battery Friedrichsort because it was too near the *Vindictive* and was no longer useful to the defense. From the point of view of fire control in the fog, the control station was useless because firing on the cruiser by its battery was impossible due to our own torpedo boats being in line of fire. He had noted that the docking and securing of the cruiser, as well as the debarkation of the landing force, proceeded very slowly and disastrously over the two remaining gangplanks in the heavy rolling of the ship. The members of the British landing force who reached the mole pressed forward along both sides of the upper runway, and some descended by the ladders to the mole platform. Not until after a half hour were the British able to clear the way with hand grenades supported by machine-gun fire from the high bridge and fighting top of the *Vindictive* and able to charge the flank defenses of the Mole Battery, over the upper runway. These men were annihilated by machine-gun fire, hand grenades, and rifle fire. It was the only separate and concentrated attack made on the mole. The only remaining British who had landed on the mole and had advanced against the Naval Air Station lying farther up the mole, against the sheds of the Z-flotilla lying across the mole from the *Vindictive,* and against the torpedo boats and destroyers lying at the wharf, hardly advanced beyond the immediate vicinity of their point of landing. As each sortie and detachment appeared to fail, one must assume that the large losses of officers and men hindered successively planned assaults.

Shortly after the assault, the *Iris* again tried to go alongside of the mole close to the machine-gun position but had to haul off quickly when taken under effective rifle fire, which later caused heavy casualties among the troops packed on her deck, even the helmsman being shot down. Lieutenant Rodewald sent back some of his men to their battery as replacements and reliefs for those who had been engaged for so long a time. With the remainder, and Lieutenant Zimmerman, he made a counterattack on the upper and lower mole in the direction of the docking place of the *Vindictive,* capturing

a machine gun which they turned against the enemy.

The destructive fire of the torpedo-boat destroyer *V-69* on the machine-gun positions on the superstructure of the cruiser silenced them and was then directed against the disembarking landing force. The flanking fire of the antiaircraft battery caused such further heavy losses to the enemy that, according to statements of prisoners captured, out of the entire expedition of 750 men of the four companies of Royal Marines and about 500 men of the bluejacket landing force, only 50 to 60 were able to land on the mole. The mole defense forces estimated this number even lower. The *Iris* in her two attempts to come alongside failed to land a single man, while the *Daffodil*, which was holding the *Vindictive* against the mole during the whole time, was able to send very few across the *Vindictive* and to the mole.

Direct and indirect fire of the shore batteries against the *Vindictive*, during the landing attempt, was impossible because of the dense fog which continued throughout the attack, enveloping everything, and because of the presence of our own men on the mole.

The hulls of the cruiser and the two tugs could not be struck by the Mole Battery and the *V-69* so long as they lay behind the high mole. Thus passed the clearing of the mole.

In addition to the previously detailed personnel for the defense of the mole, the harbor company stationed on the mole and the crews of the destroyers and torpedo boats accomplished good results in shooting down, with rifle fire, the British in sight on top of the high mole and engaging and annihilating the few who descended to the lower platform. They captured two flame throwers and one machine gun. The fight became a bitter hand-to-hand fight between individuals. A bluejacket, Künne, of the *S-53*, and a British lieutenant commander killed each other in a hand-to-hand fight with cutlasses and pistols. Only the two hundred men of the Naval Air Station placed on the mole to protect the aircraft sheds were unable to take part in the fight, because, due to the greater distance of the landing point from the sheds, no British came into view. The difficult conditions of visibility caused by the fog made it inadvisable for them to leave the vicinity of the airplane sheds.

About 0140, the *Vindictive* was towed away from the mole by the tug *Daffodil*. She not only gave up the attempt to land more troops, but hurried the unmooring on account of the heavy and damaging fire, so that she did not even await the return on board of the personnel who had landed. After the unmooring of the *Vindictive*, one officer and thirteen men surrendered as prisoners to Gunner Westphal and the shock troops. According to their accounts, the landing force had orders to destroy all installations on the mole and all of the craft lying in the harbor. After unmooring, the *Vindictive* and her two tugs were again taken under fire by the Mole Battery, singly and at short range. A large number of hits were made, especially on the tug *Iris*, which suffered heavy damages. The captain of the *Iris* and the commander of the Royal Marines, who were embarked on board, as well as a large number of officers and men, fell. The *Iris* had very little luck in the undertaking. Without having landed a single man, or having accomplished anything, she returned home with heavy damages. The three ships were lost to view in the fog.

Thus the attempt to land on the mole was repulsed. One may state, when one considers the published accounts of the losses of the whole operation, that from 82 officers and 1,698 men of the blocking ships and landing expedition, the percentage of loss of 214 killed, 383 wounded, and 19 prisoners, is quite high. By far the greatest part of the losses may be assigned to this foolhardy undertaking with three unprotected ships. This was most costly to the British. The defenders of the mole accomplished a very successful piece of work on that night. Our own losses at Zeebrugge were 8 men killed and 14 men wounded.

BLOWING UP THE BRIDGE LEADING TO THE MOLE

At 0119 the enemy blew up the iron bridge structure which connected the stone mole with the shore and formed a passage through the mole for the ebb and flow of the tide, in order to prevent reënforcements coming from the shore. The break was about forty meters wide. The blowing up was accomplished by a submarine carrying a large cargo of explosives, run under the bridge in the fog and blown up there. In this way all communication with the mole,

even by telephone, was cut off. The mole was converted into an island, and the British assumption, supported by their air observations and other advance information, was that it was meagerly occupied. Actually, there were on the mole 70 men of the Harbor Company, 200 men of the Naval Air Station, 60 men of the Mole Battery. The crews of the torpedo boats lying in the harbor were made available in very small parties for duty on the mole.

Opposed to these were the four companies of the Royal Marines, 750 men, and a bluejacket landing force of about 500 men carried by the three ships; a comparatively great difference, but our forces were entirely sufficient to handle the British.

Since there were no casualties in personnel resulting from the blowing up of the bridge, this undertaking was useless, except insofar as concerned the damage done to the structure. An officer patrol sent from the shore crossed over the wreckage soon after the explosion but did not get into action because the *Vindictive* had already cast off. Even the telephone connections were reëstablished while the fight was in progress. A temporary bridge was erected over the gap within ten hours after the assault and sufficed for traffic between the mole and the shore. This, in turn, was later replaced by a footbridge brought from Brugge.

The Blocking Assault on The Harbor of Zeebrugge

Some time after the *Vindictive* had passed the Mole Battery and gone alongside of the outboard side of the mole, three torpedo boats were sighted momentarily off the harbor entrance in the illumination of star shells and were taken under fire by the two 8.8 guns of the Mole Battery. The boat nearest the harbor was sunk by direct hits. Shortly after, about 0110, in the illumination produced by the star shells fired by the shore batteries, a cruiser appeared out of the fog at short range on a course for the harbor entrance. Since the *Vindictive* was by this time in the dead angle for the Mole Battery and could not be fired on, the commander of the Mole Battery opened fire with his five guns on the incoming cruiser. The artificial fog had prevented the Mole Battery from sighting this first blocking ship until she was so close that only two salvos could be fired at her before she passed the lighthouse. After passing the lighthouse, the blocking ship, which proved to be the cruiser *Thetis,* received salvo after salvo at point-blank range. The ship proceeded with left rudder, ran into the net defenses, missed the canal entrance, ran aground, and was sunk in the harbor.

About 0120 two more blocking ships, the *Iphigenie* and the *Intrepid,* came into view, one immediately after the other. Both were so completely hidden in the fog that only the upper works were visible. The ships ran through the fire of the harbor defenses, altered course sharply around the lighthouse at the end of the mole, themselves firing and being under the fire of the Mole Battery, the revolving cannon mounted on the barge moored to the inshore side of the mole at the lighthouse, as well as under the fire of the torpedo boats lying in the harbor. The rear blocking ship was taken under direct fire by Battery Friedrichsort as well. In spite of the numerous direct hits that they received, they broke through our boat and net defenses, reached the canal entrance, and were sunk there. Soon afterward, a torpedo motor boat was taken under fire by the Mole Battery. It burst into flames and sank. Then, an enemy destroyer, approaching the harbor entrance, was taken under fire by the Mole Battery. This destroyer and the motor boats fired a number of torpedoes, all of which failed to register hits in the fog except two, one detonating against the mole without doing any damage, and the other sinking a dredge. The barge carrying the revolving cannon was hit by shell fire and sunk; the personnel saved themselves by landing on the mole. At 0210, a British destroyer on whose bow *F-53* could be read, came into sight close inshore. It was taken under fire successively by the Batteries Augusta, Freya, Kanal and Friedrichsort and then by the Mole Battery at about 2,000 meters range and sunk. It was this destroyer, the *North Star,* whose wreck was later visible at low water. Another vessel was sunk by Battery Augusta and in the early dawn Battery Württemberg sank a motor boat.

The object of the blocking attempt on April 23, 1916, was, as previously mentioned the blocking of the narrow harbor entrance of Ostend and the blocking of the Zeebrugge-Brugge canals emptying into the harbor of Zeebrügge, in order to bottle up

the torpedo-boat destroyers, torpedo boats, and submarines lying at the main base of Brugge. The enemy hoped in this manner to eliminate the German submarine warfare from the nearby Flanders coast, which so seriously threatened the trade routes of the English Channel. At the same time, the assault on the mole of Zeebrugge was to serve as a diversion to draw the attention of the coast defenses from the blocking attempt and to insure the destruction of the military installations on the mole, the batteries and fire-control stations, the torpedo boats and submarines lying in the harbor, and particularly the Naval Air Station with its seaplanes.

The British papers which had come into our possession showed that excellent plans had been drawn up and careful preparations had been made months before, but in spite of these, the enemy were not successful. They were frustrated by the watchfulness and the determined action of all involved units of the defense of the two harbors. At Ostend, the effort of the two blocking ships was entirely unsuccessful. Under the fire of the coast artillery, they missed the harbor entrance and ran aground. At Zeebrugge, the British assault on the mole was repulsed with heavy losses without having been able to accomplish any destruction.

This attempt to storm the mole by going alongside the outboard side in the heavy swell of the North Sea with one small cruiser and two unprotected steamers, all loaded down with the landing force of over 1200 men, was planned as a surprise attack in the fog and was based on luck and an underestimate of the enemy. The surprise in the fog was not accomplished. The alarm was given to the batteries by the long-range bombardment. The sharp and well-placed fire of the Mole Battery on the cruiser when it came into view inflicted heavy losses in officers and men of the landing force and robbed the ship of practically all means necessary for accomplishing a speedy landing of a large force. The success of the landing thus became questionable. The landing was frustrated when, at the point of landing, the fire of the machine guns, of the battery of the torpedo-boat destroyer *V-69*, and the rifle fire of the defenders produced such heavy losses, shattered the organization and direction of the landing force, so that only about fifty or sixty men ever landed on the mole. Of these nineteen were taken prisoners, and of the remainder some were shot down by the defenders of the mole, while some jumped over the breastworks into the water. Several succeeded in returning to their ship in the fog. As a diversion, the assault of the mole never entered into the question, since the coast batteries did not open fire on the *Vindictive* while she was alongside the mole because of the danger to our own forces and because of the impossibility of observing the assault in the fog.

Since the Mole Battery could fire on the *Vindictive* only during the short time of passage through their arc of fire, their successful efforts could be turned to other targets, namely, the units attempting to block the harbor. In the effort to block the channel, the first blocking ship grounded in the harbor clear of the canal entrance and was sunk. Both of the blocking ships which followed were able to reach the canal entrance and sank themselves there. The locks of the canal, about five hundred meters from where the blocking ships were sunk, the destruction of which would have completely blocked the canal fairway, was not reached by any ship. The position of the blocking vessels in the fairway of the canal did not suffice to completely block the fairway no matter how clearly various photographs seemed so deceptively to show. Clear passage at high water was made even on the following day. At high water on April 24, 1918, the vessels of the Second Flanders Torpedo-Boat Flotilla passed through the channel which was restricted by the two blocking ships, and on April 25, 1918, the first submarine, the *UB-15*, also passed through.

Dredging operations were commenced immediately with three dredges, aided by spilling operations of the dammed-up waters of the canal, so that on May 15 there was a channel of 3.5 meters depth at low water passing westward of the sterns of the two blocking ships, and the torpedo vessels and submarines of the Marine Corps had complete freedom of passage. After the guns and ammunition of the wrecks of the three sunken ships had been salvaged, they remained where they had been sunk, since the channel was amply wide for the passage of our Flanders fighting ships. The submarine warfare from the Flanders coast suffered

no interruption through this effort to block the harbors, as the harbor of Ostend remained entirely clear. Traffic could proceed undisturbed via the Brugge-Ostend canal during the dredging operations.

A review of the forces and losses admitted by the enemy is summed up as follows. Taking part in the assault, the bombardment, and escorting the expedition were: nine monitors, seven small cruisers, twenty-eight destroyers, five blocking ships, two tugs, two airplane squadrons, one scout, fifty-seven motor launches, twenty-four motor boats, two old submarines filled with explosives. In addition there were detailed to escort the expedition: three French destroyers, four French torpedo boats, and four French motor boats. Besides the five sacrificed blocking cruisers and the blown-up old submarine, the British lost the following vessels: the modern war-built destroyer *North Star,* sunk by our gunfire and, according to the survivors who were rescued and taken prisoners by the Second Flanders Torpedo Flotilla on the following morning, two torpedo motor boats and a number of smaller boats. The destroyer *Phoebe* sustained heavy damages. On the German side, one barge and one dredge were sunk.

The British losses in personnel were divided as follows:

Of the 82 officers and 1,698 men taking part in the blocking attempt and the landing assault, there were killed and wounded:

Royal Navy	*Officers*	*Men*
Killed	11	79
Missing		21
Wounded	17	150
Total	28	250
Royal Marines		
Killed	9	96
Wounded	11	205
Missing	2	13
Prisoners		2
Total	22	316

This summing up is in error in the number of prisoners taken, which number we can give definitely as 1 officer and 18 men instead of 2 prisoners as stated.

The remaining 19 missing should be counted as killed.

Therefore, the total loss of the British was 214 killed, 383 wounded, and 19 prisoners.

The German losses were:

Ostend: 2 men killed, 2 men wounded.

Zeebrugge Mole Battery: 2 men killed, 2 men wounded.

Second Destroyer Half Flotilla: 5 men killed, 11 men wounded.

Second Torpedo Half Flotilla: 1 man killed, 1 man wounded.

Total: 10 men killed, 16 men wounded.

The British reports contend that these undertakings accomplished their purposes. The two following telegrams, which have not heretofore been given out for publication, will show the impression received by His Majesty, the Kaiser, and the chief of staff of the Admiralty, on an inspection of Zeebrugge on the succeeding days. His Majesty, keenly interested in all naval undertakings, proceeded immediately to Zeebrugge upon receipt of the news of the repelled assault. After inspecting the mole and the harbor and after receiving the report of the commanding admiral of the Marine Corps, Admiral von Schroeder, His Majesty sent the following telegram to the General Staff:

Court Train, April 24, 1918. The major undertaking by the British, prepared for months and carried out last night, has been frustrated. The enemy's aim was to render the harbors of Ostend and Zeebrugge useless, particularly by destroying the locks and all military installations on the mole and blocking the canal exit. Two small cruisers of the *Sirius* class fitted out as blocking ships were sunk on the coast eastward of Ostend. Three other small cruisers of the same class were able to enter the harbor of Zeebrugge in the dense artificial fog and were sunk there. The mole was blown up by the enemy near the shore end. The cruiser *Vindictive,* 5,200 tons, went alongside the mole and the landing force attempted to land on the mole with the aid of emergency gangways and ladders and under the protection of flame throwers. In the heavy fighting the enemy was beaten back with sanguinary losses and the cruiser was later towed away by two tugs. Naval Air Station and other installations on the mole undamaged. About two enemy destroyers and a large number of British torpedo boats sunk by our batteries. Total losses on our side very small. Captain Palmer of the Royal Light Infantry taken prisoner on the mole during the landing operation, was introduced to me and made an excellent impression. As a result of the undertaking he replied "I took a sporting chance but failed, chance of war." Signed: WILHELM; signed: V. MÜLLER.

The chief of staff of the Admirality, Admiral von Holtzendorff, who personally inspected Zeebrugge on April 25, 1918, sent

the following report to the Admiralty staff in Berlin:

> Please reply emphatically to unwarranted criticism that the impression gained by me personally is that the repulse of the well-prepared and smartly executed British assault by our brave defenders was a complete and shining success. It must be made clear to laymen that the reports of the attackers, designed for their effect on the people, came through quicker than from those assaulted by surprise in the protection of thick weather. In addition, the immediate arrival of His Majesty in person, caused a delay of a half day in rendering the report by the local commander. From the impression gained here any effort to detract from our success is unwarranted and an insult to our own most trustworthy troops. Signed: v. HOLTZENDORFF.

The latter telegram indicates that in the German press there were observations about the slowness in publishing the German reports on the fight, a fact that can be understood when the circumstances under which the report was prepared are considered.

As a sign of his satisfaction with the eminent performance of the heroic personnel, His Majesty expressed his warmest recognition and at the same time bestowed high honors on the commanding admiral, Admiral von Schroeder, the chief of staff, Major General Bertlet, the commander of the Mole Battery, Lieutenant of Reserves Schütte, the captain of the *V-69*, Lieutenant Benecke, Passed Midshipman Klintzsch, Lieutenant of Reserves Zimmermann, and Chief Gunner's Mate Scheidt, acting as gunner; and distributed a large number of iron crosses to the officers and men of the various units engaged in the fight.

BRITISH BLOCKING ATTEMPT AT THE HARBOR OF OSTEND ON MAY 10, 1918

After the unsuccessful blocking attempt of April 23, 1918, and according to information received, an early effort was planned to repeat the attempt to block the harbors of Ostend and Zeebrugge. The coast defenses remained alert and made use of the time to profit by the experiences of April 23. In particular, the short-range artillery at the harbor entrances was materially increased. The night of May 10, 1918, was very dark, the air clear and a "force three" breeze was blowing onshore from W.N.W. Favorable

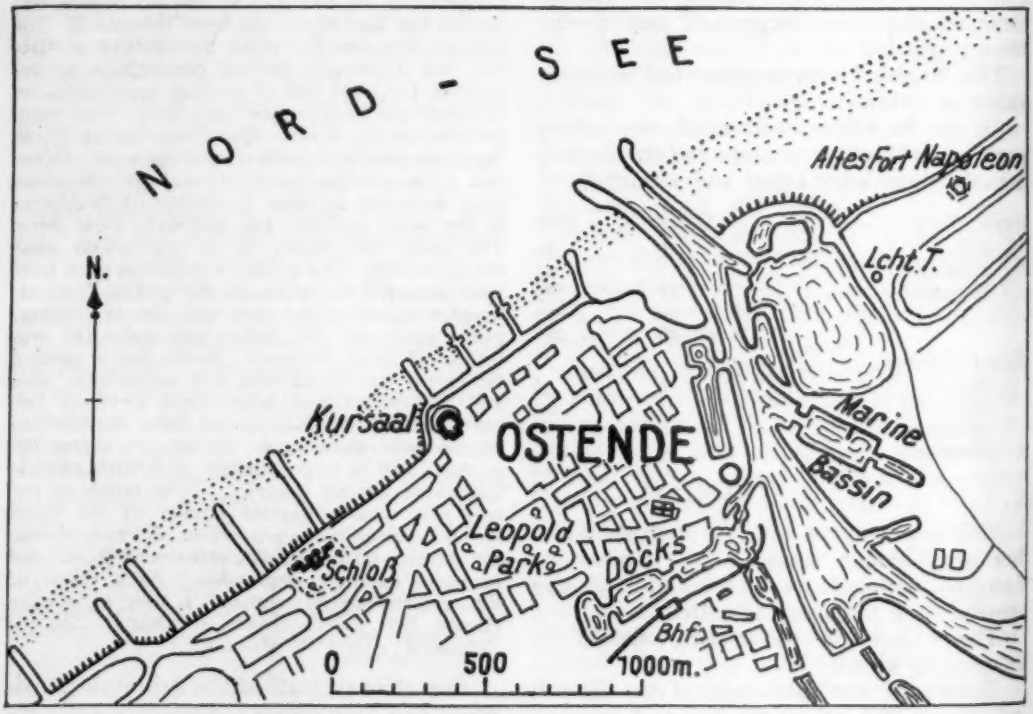
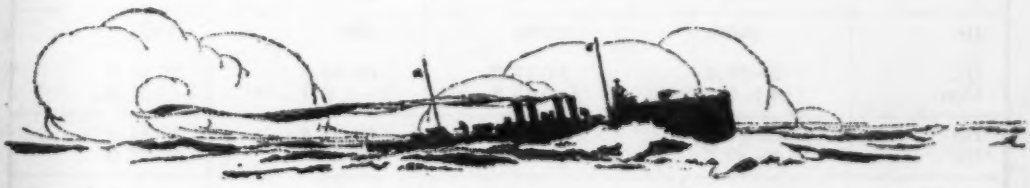


FIGURE 3

high water was at 0130. The favorable wind and smooth sea made an assault probable. Before each, Ostend and Zeebrugge, two torpedo boats were on patrol. At 0245 simultaneously with the alarm signal and radio reports from the patrol vessels, a heavy bombardment of our coast batteries was commenced by four monitors at a range of fourteen to eighteen kilometers. The bombardment was again augmented by the fire of several heavy batteries beyond the Yser. The bombardment by the enemy made the alarm order of the coast batteries superfluous, and the fire was returned with the assistance of the sound-ranging details who could observe the flash of the enemy guns. In a short time the artificial fog bank approached the coast rapidly and remained very dense throughout the undertaking. About 0305 several larger vessels were sighted close aboard the harbor entrance and were taken under concentrated direct fire by the shore batteries. In the fog and the defensive fire they failed to find the entrance —according to the statements of prisoners— and were obliged to cruise about for some time under the fire of the shore batteries. After about half an hour, the blocking ship *Vindictive,* after repeated attempts, succeeded in reaching the harbor entrance. However, she passed too close to the eastern mole and ran aground on a sand spit eastward of the channel. She thus failed in her blocking attempt, since she grounded parallel to and on the edge of the channel and left the channel clear. According to the operation order found on board, the undertaking was prepared with careful consideration of the minutest details, and had as its objective the blocking of the harbor of Ostend. According to statements of prisoners, the second of the blocking ships prepared for the operation, the cruiser *Sappho,* which accompanied the approach on Ostend, failed to reach the harbor entrance because of engine trouble close to the harbor entrance. Thus the second effort to block the harbor of Ostend failed completely. In addition to the two blocking ships, the following vessels took part in the undertaking: four monitors, twelve British and three French destroyers, and more than twenty motor boats and escorting vessels. Their duties were to protect the monitors and blocking ships, to lay the smoke screen, to lead and escort the blocking ships. It cost the British the blocking ship *Vindictive,* two motor boats sunk by gunfire and, according to British reports, four officers and twelve men killed, five officers and twenty-six men wounded. Three men of the *Vindictive* were taken prisoners and twelve were found on board, dead. The bombardment, which resulted in the expenditure of a large amount of ammunition, caused only slight damage because most of the shots went over. Our losses were three men dead, eight men wounded. After the guns and ammunition had been salvaged from the *Vindictive,* she remained lying where she had grounded, since she did not interfere with passage through the channel.

Thus the last British blocking attempt, which was again unsuccessful and had no effect on the submarine operations from the Flanders coast, was defeated.

The feeling of superiority of the troops over the attacking enemy was strengthened by these unsuccessful and disastrous enemy efforts. The excellent morale of the troops of the Marine Corps and the splendid fighting spirit which here again gloriously manifested itself, were the result of the sure leadership and direction of the corps by Admiral von Schroeder, whose high military and personal qualities made him a born leader, who had the confidence of everyone.



Form Suggested *for the* Line *of* Position

By LIEUTENANT COMMANDER P. V. H. WEEMS, *U. S. Navy*

"IF YOU 'ave a better 'ole, go to it!" but if you are not wedded to a pet arrangement for navigation work, we offer for consideration the idea of the vertical form. When we consider the time and labor spent in writing navigation forms and in unnecessary repetition of numbers, we realize that it would be no small gain to overcome both of these troubles.

The short method of working the line of position by Ogura's altitude tables and Rust's azimuth diagram lends itself nicely to a standard universal form, which is available for *all bodies, at all times, and under*

	I	II	III	IV
	0857 SUN	1800 ANTARES	1845 SATURN	1650 MOON
	h m s	h m s	h m s	h m s
W	8–37–45	6–02–10	6–45–00	4–50–15
C–W	3–40–45	9–10–24	8–51–16	3–08–16
C	12–18–30	15–12–34	15–36–16	7–58–31
CC	(+) 1–50	(+) 15–18	(+) 8–43	(−) 4–08
GCT	12–20–20 (23)	3–27–52 (3)	3–44–59 (3)	19–54–23 (3)
RAM ⊙		0–44–42.9	18–41–59.9	14–41–30
ET–RED	(−) 13–35.5	0–24.8	0–37.0	3–15.7
GST		4–12–59.7	22–27–35.9	10–39–08.7
RA		16–24–49.3	14–24–34.5	11–02–03.5
GHA(time)	0–06–44.5	11–48–10.4	8–03–01.4	0–22–54.8
GHA(arc)	1°–41′.1	177°–02′.6	120°–45′.4	5°–43′.7 E
Long.(Ass'd)	50°–41′.1	141°–02′.6	134°–45′.4	46°–16′.3
LHA	49° E	36° W	14° E	52°–00 E
Lat.(Ass'd)	38° N	21° N	15° N	26°–00 N
Dec. (T)	10–05.4 S	26–16.0 S	11–44.8 S	9–34.6
Corr.	(−) .3	0	0	(−) 19.1
Dec.	10–05.1 S	26–16.0 S	11–44.8 S	9–15.5 N
K	49–58.8	25–23.0 N	15–26.0 N	38–23.0 N
K∼dec.	60–03.9	51–39	27–10.8	29–07.5
A	9478	7780	1219	15123
B	30191	20728	5082	5867
Hc	39669	28508	6301	20990
Hs.	23–39.0	31–17.0	60–02.5	37–24.0
Corr.	(+) 7.2	(−) 7.5	(−) 6.7	(+) 51.8
Ho	23–37.2	31– 9.5	59–55.8	38–15.8
Hc	23–39.0	31–14.8	59–52.5	38–05.0
a ϕ	1.8 Away	5.3 Away	3.3 Toward	10.8 Toward
Zn ϕ	125.8	217	152	100

all conditions. The form may be written in the left margin of page one; then by cutting a half-inch from the following pages, or by using a form on a strip of celluloid, one form suffices for the entire book; each element appears on the same line throughout the book; each problem appears in one column; and there is *no repetition.*

The difficulties in using such a form are that the form for the sun and the form for the moon and stars differ slightly, and that the logarithms are written below instead of to the right of the arguments. This difficulty is met by leaving three lines blank when working on a sun line. Since it is largely habit which determines the relative positions of logarithms and other data, we see no reason why a beginner, if not others, should not adopt a system which offers obvious advantages. With practice, the arrangement of this form would seem just as natural as any other, and its good points utilized.

Furthermore, the bugaboo of complicated forms for problems, which does so much to discourage the beginner, would be reduced to *one simple form.*

Solutions by Standard Form

To illustrate the form described, the solutions of four problems is shown on the preceding page, using the sun, a star, a planet, and the moon.

I. The typical problem worked on page 10 of the *Line of Position Book.*

II. (Dutton, p. 241, Problem 6). During evening twilight on October 2, 1925, the navigator of the U.S.S. *Chaumont,* in D.R. position Lat. 21°-18′N., Long. 141°-24′W., observed the star Antares for a line of position as follows: W=6-02-10, C-W=9-10-24, Chro. slow 15^m-18^s, h_s=31-18-15., I.C. = (-) 1′-15,″ ht. of eye 35 ft. Find the altitude difference and azimuth.

III. (Dutton, p. 241, Prob. 10). On July 2, 1925, P.M., in D.R. position Lat. 15°-06′N, Long. 134°-19′-15″W, the navigator observed the planet Saturn for a line of position as follows: W=6-45-00, C-W=8-51-16, Chro. slow 8^m-43^s, I.C.(-)2′-30″, ht. of eye 36 ft., h_s=60-05-00. Find the altitude difference and azimuth.

IV. (Dutton, p. 241, Prob. 12). On May 3, 1925, P.M., D.R. Lat. 26°-17′N, Long. 46°-02′W, obs. moon's lower limb as follows: W=4-50-15, C-W=3-08-16, Chro. fast 4^m-08^s, I.C. (+) 2′-00″, ht. of eye 40 ft., h_s=37-22-00. Find the altitude and azimuth.

Work in the Air

For lines of position worked in the air, certain short-cuts are both permissible and necessary. In the first place, an aerochronometer will give the GHA in time direct, while the refinements in correcting the declination and altitude are not required. In order to show the kind of work done in the air four actual sights are given below.

On the morning of 28 November, 1927, the Navy mail plane rounded Point Loma at 1020 (zone plus eight time) and headed for Oceanside making good one mile per minute. The following sights were taken:

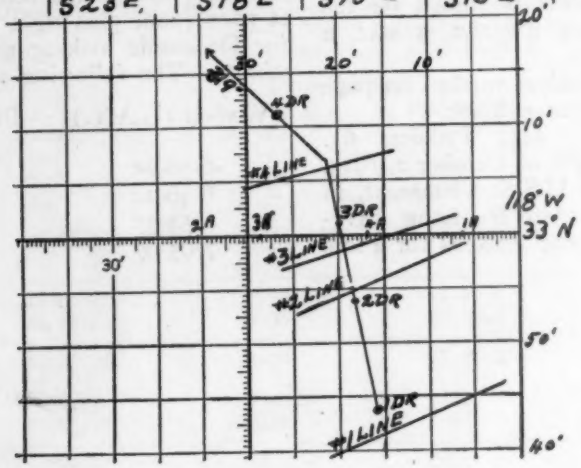
Watch (G.A.T.)	Bubble Sextant Altitude
6-36-25	33-21
6-46-22	33-49
6-53-55	34-12
7-05-07	34-40

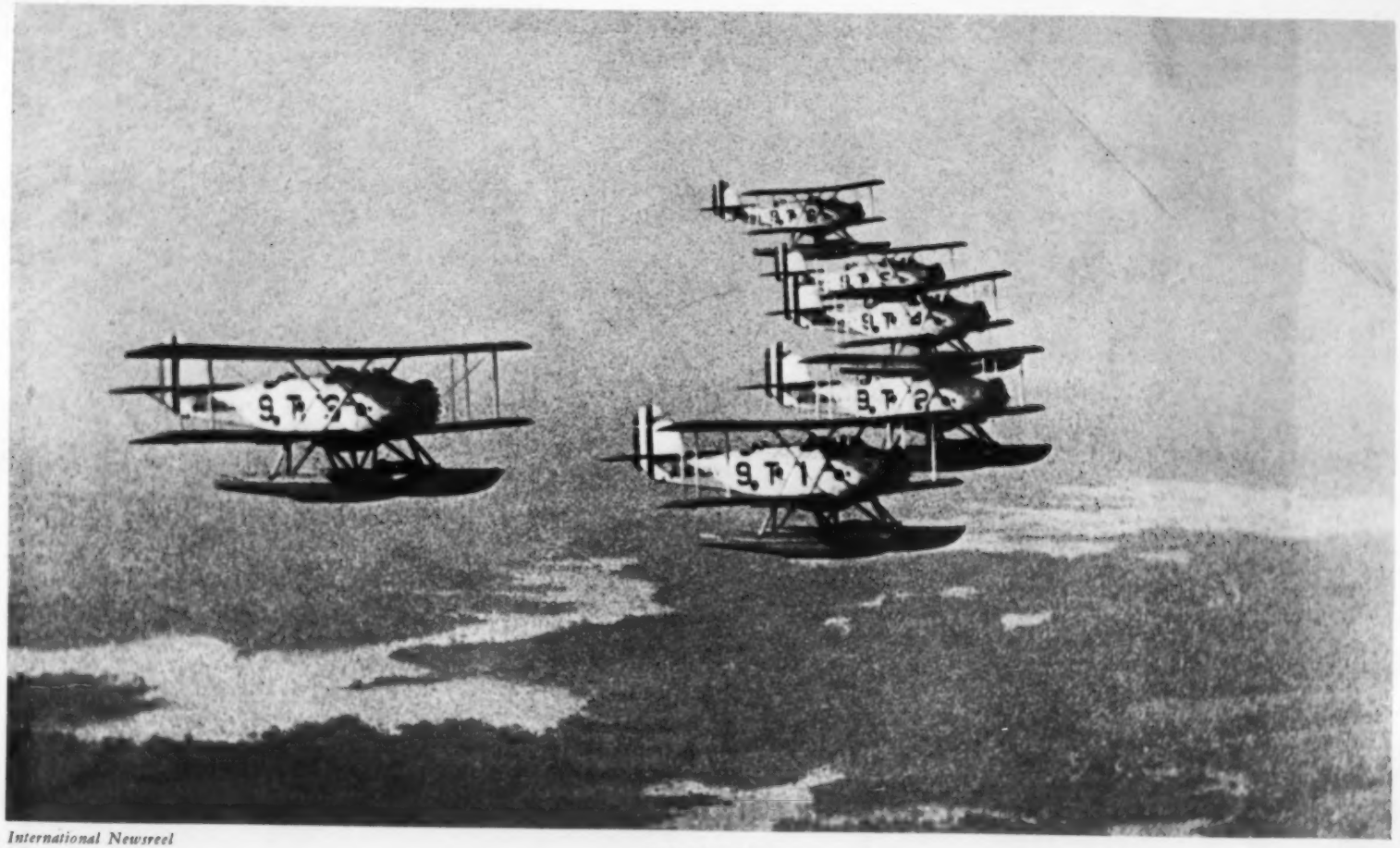
SOLUTION

PASSAGE SAN DIEGO to SAN PEDRO DATE 28 Nov. 1927.

A.M.	1	2	3	4	5
GCT (or GST)					
EQT (or RA)					
GAT					
GHA (Time)	6-36-25	6-46-22	6-53-55	7-05-07	← WATCH
GHA (arc)	99°-06.3	101°-35.5	103°-28.8	106°-16.8	
Long (assumed)	117-06.3	117-35.5	117 28.8	117-16.8	
LHA	18°E	16°E	14°E	11°E	
Lat (assumed)	33°N	33°N	33 N	33°N	
Dec.	21-14.1S	21-14.2S	21-14.3S	21-14.4S	
K	34-19.6N	34-02.5N	33 47.8N	33-29.0N	
K ~ DEC.	55-33.7	55-16.7	55-02.1	54-43	
A + -	1510	1193	913	563	
B	24761	24449	24177	23836	
Log Hc	26271	25642	25090	24399	
Hc	33-06	33-39	34-08	34-46	
Ho	33-20	33-48	34-11	34-39	
a	14'T.	9'T.	3'T.	7'A.	
Z	S23°E.	S18°E	S15°E	S13°E	

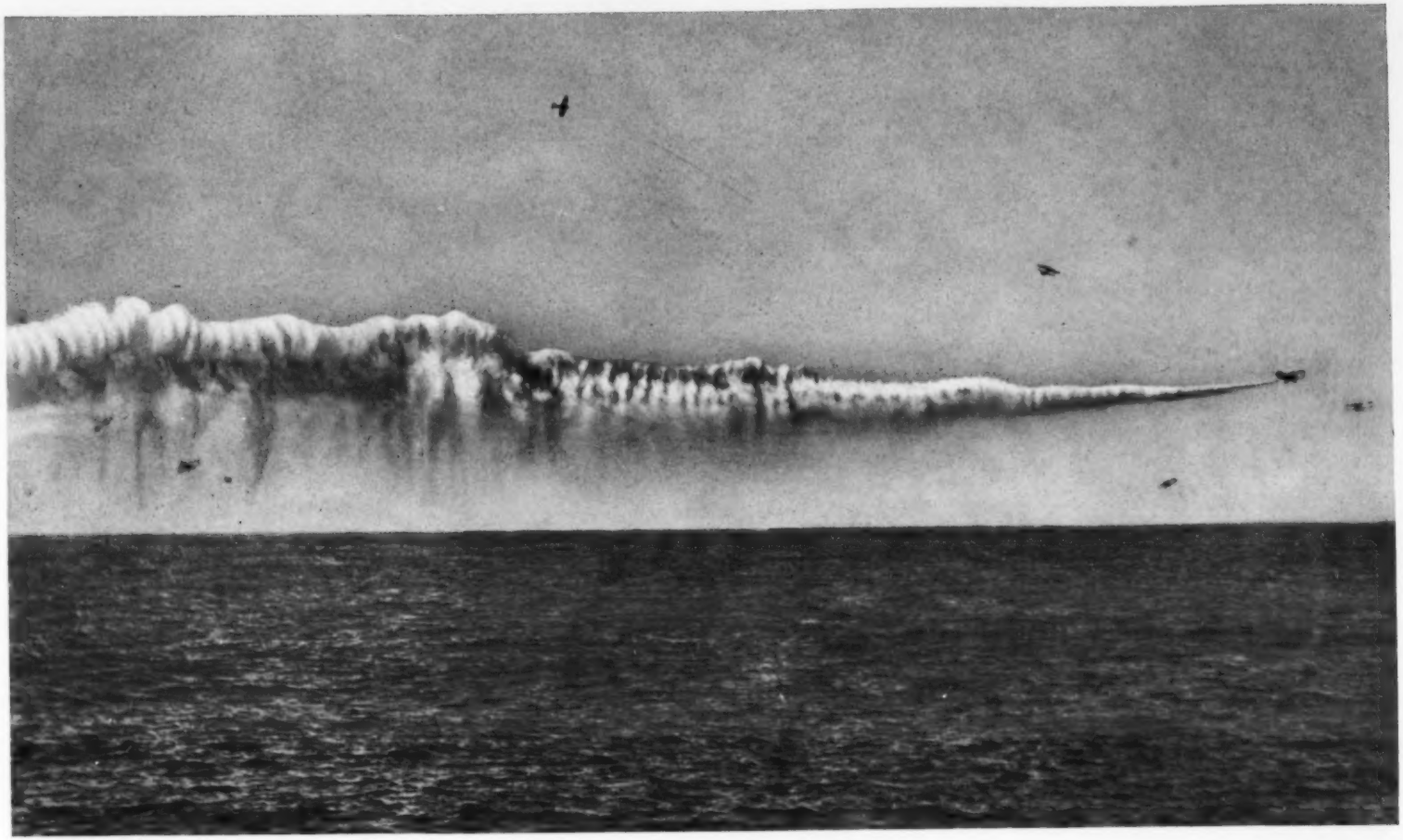
SINGLE OBSERVATIONS WITH BUBBLE SEXTANT TAKEN IN NAVY NAIL PLANE





International Newsreel

NAVY PLANES
Making air attack on Canal Zone defenses.



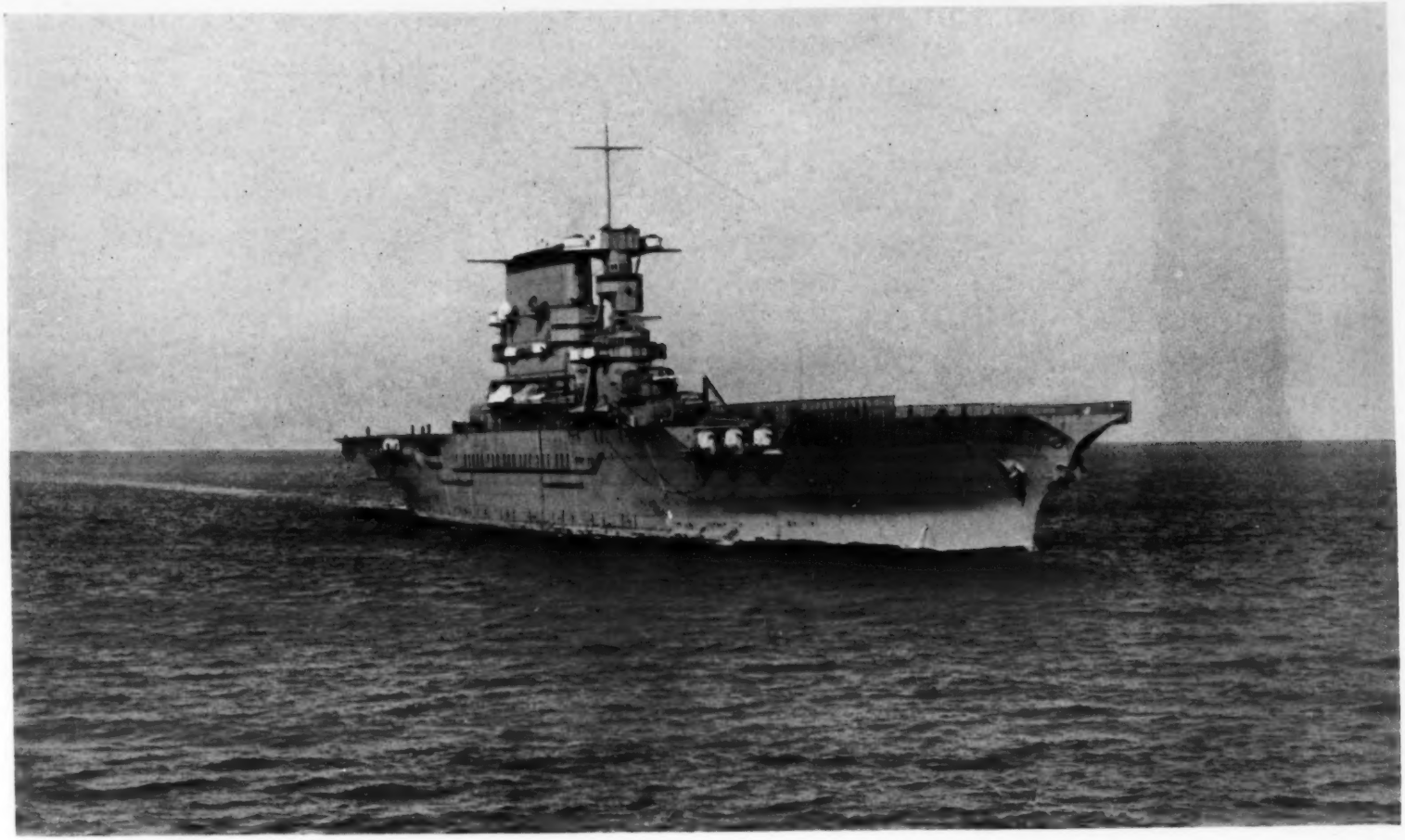
Herbert Photos, Inc.

PLANES IN MANEUVERS OFF CALIFORNIA COAST

International Newsreel

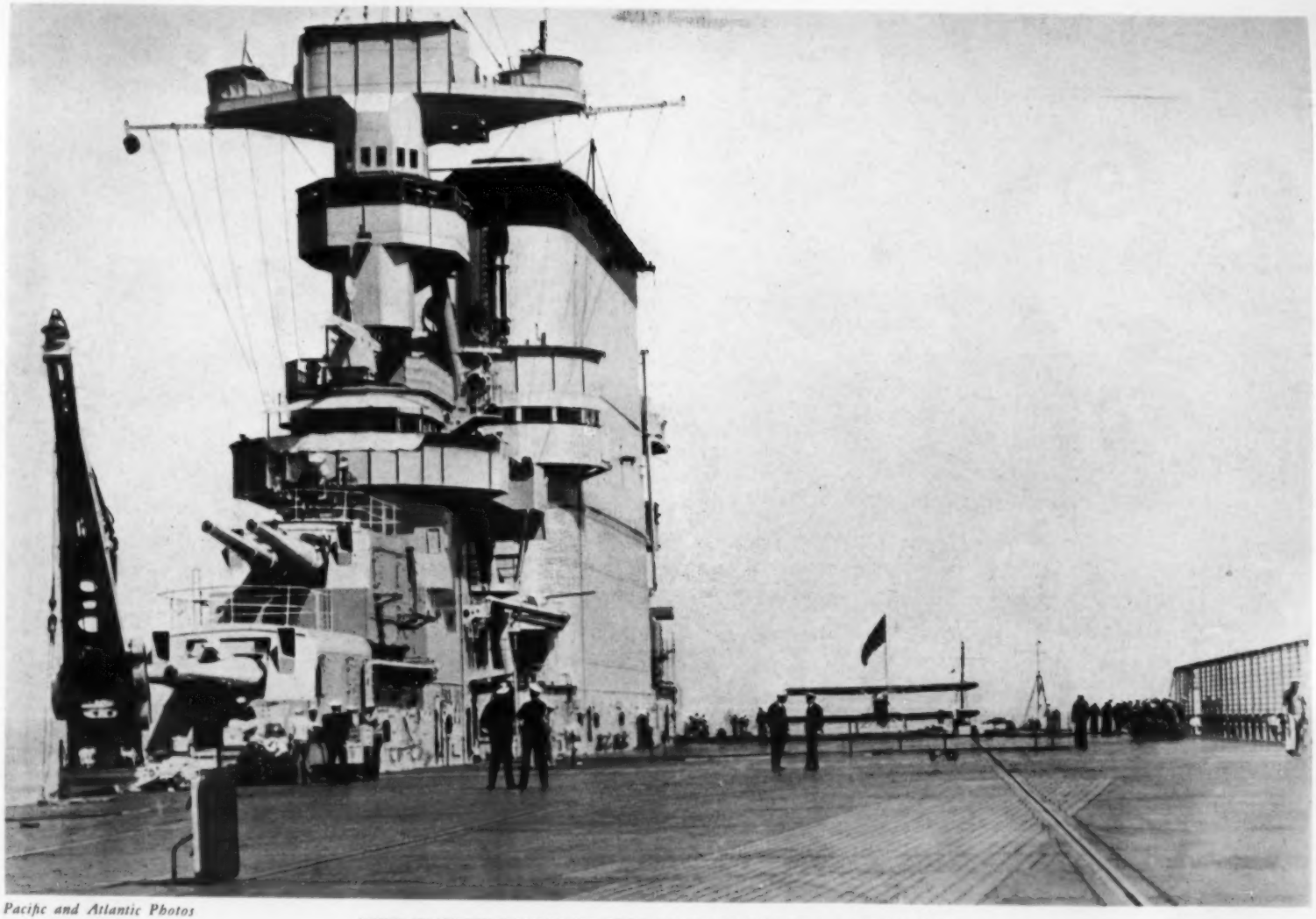
GREAT BRITAIN AND COMMERCIAL AVIATION

This giant of the air has just completed an air-mail trip from India to London, England (April 24, 1929).



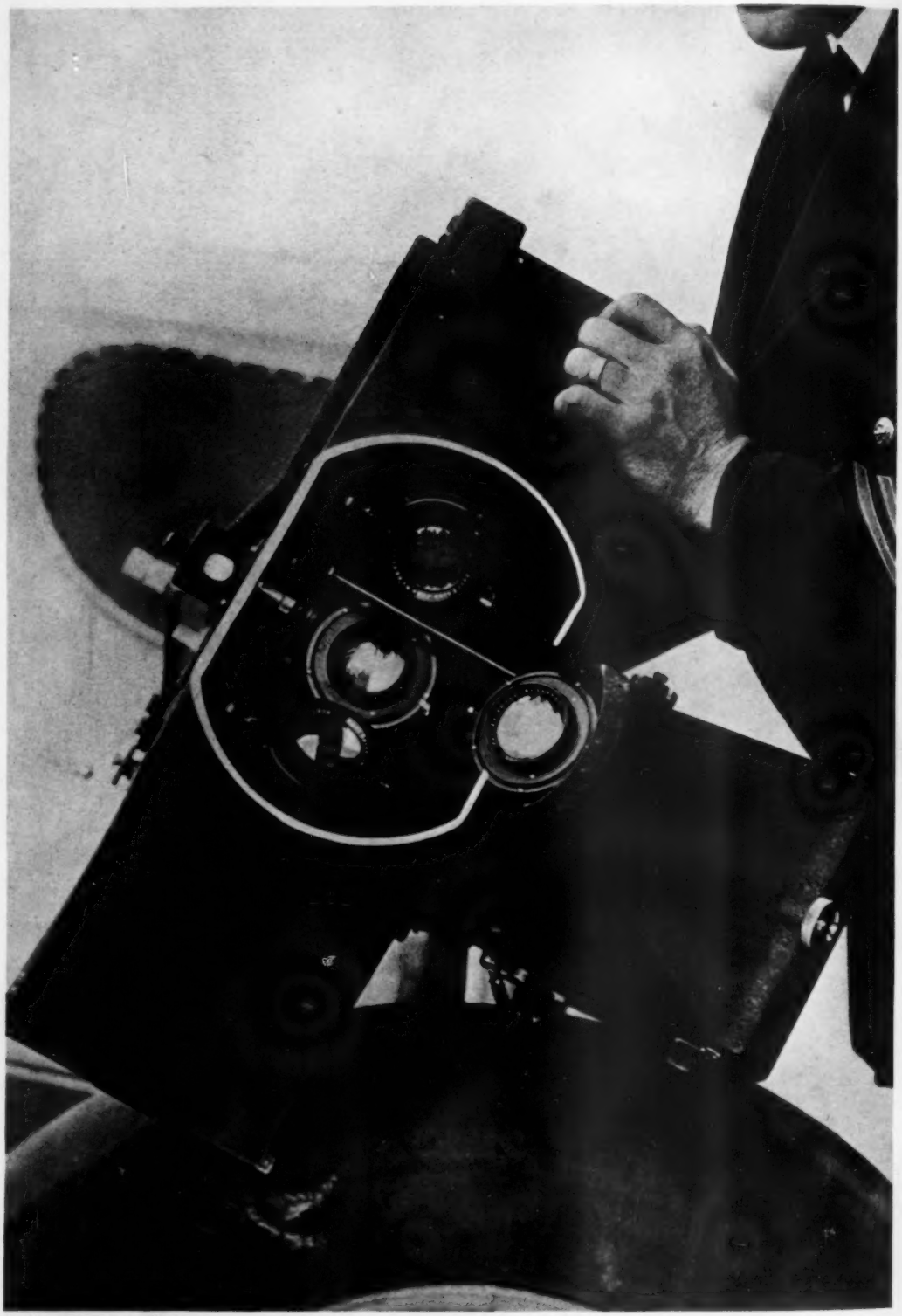
Courtesy Bureau of Aeronautics, Navy Department

THE *LEXINGTON* AND *SARATOGA* ARE THE WORLD'S LARGEST FLOATING AIRDROMES



Pacific and Atlantic Photos

VIEW SHOWING ENORMOUS DECK SPACE ON THE U. S. S. *LEXINGTON*



Pacific and Atlantic Photos

THE NAVY'S SECOND AERIAL MAPPING EXPEDITION

This expedition will map Chickagof and Baranof Islands. Photo shows camera to be used, and the position of the four lenses.

Pacific and Atlantic Photos

ONE OF THE NAVY PHOTOGRAPHIC PLANES
Over Mendenhal Glacier, Alaska, on a previous expedition.

International Newsreel

BALLOONS ABOUT TO TAKE OFF

The start of the national elimination balloon race, from the University of Pittsburgh stadium. The Navy entry, Lieutenant T. G. W. Settle, pilot, and Ensign Wilfred Bushnell, aide, won the race after covering approximately 900 miles.

Wilfred Bushnell, aide, won the race after covering approximately 900 miles.

Courtesy Captain H. B. Grow, Inspector General of Aviation, P.N.

Photo by Lieutenant G. W. Johnson, Peruvian Naval Air Force

IN THE HANGAR AT SAN RAMON, PERU
Peruvians are interested in their airways.

Courtesy Captain H. P. Grow, Inspector General of Aviation, P.N. *Photo by Lieutenant G. W. Johnson, Peruvian Naval Air Force*

TYPE OF COUNTRY PASSED OVER BY PERUVIAN AIR-MAIL AND PASSENGER SERVICE

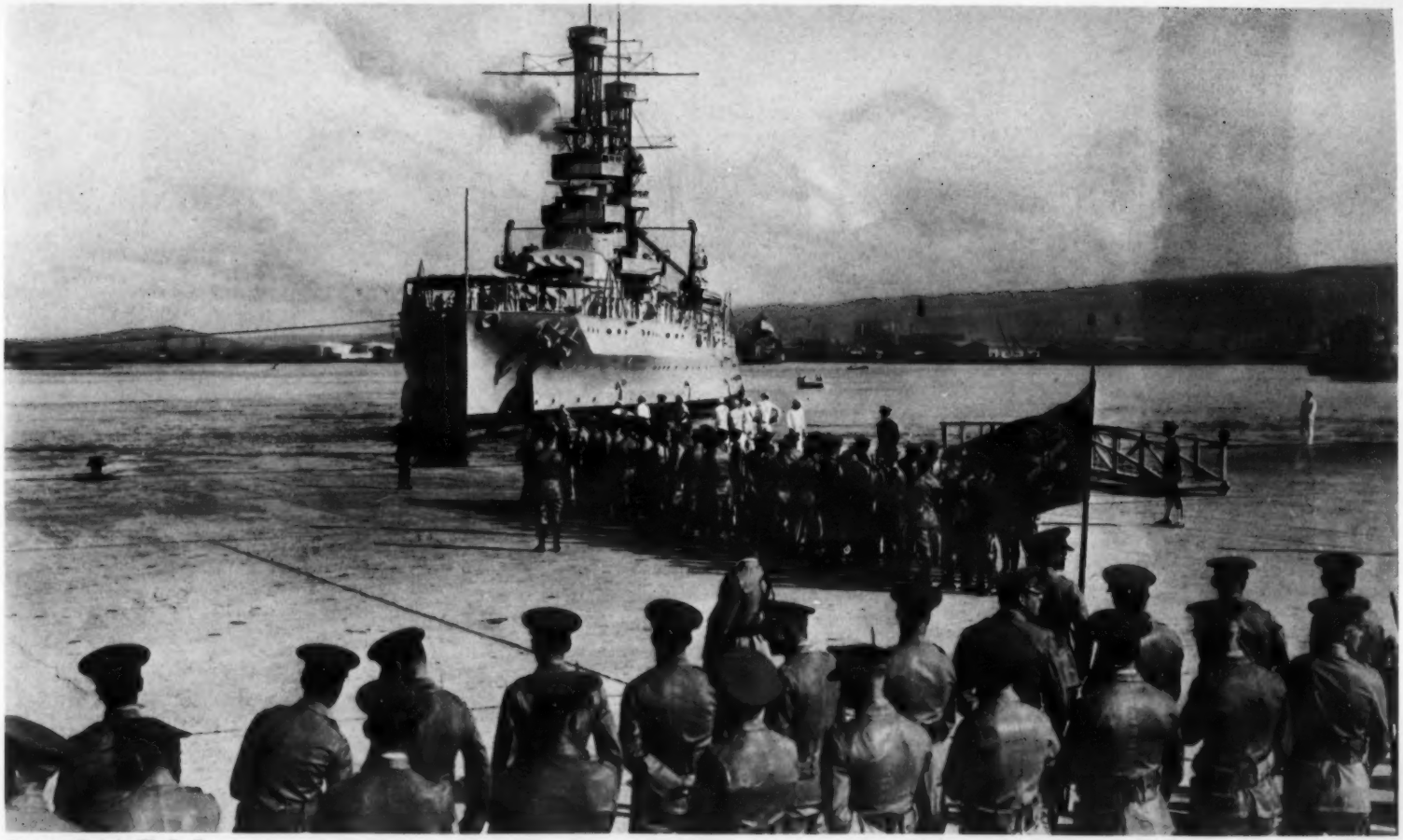
Courtesy Commander D. M. Wood, U. S. Navy (Retired)

H. M. S. *RENOWN*
Entering Manila Bay, May 17, 1922, with the Prince of Wales on board.

International Newsreel

HOMEWARD BOUND

Navy planes over Miami, on their return from Panama and Caribbean waters (April 4, 1929).



Courtesy Captain W. R. Foster

U. S. S. *PENNSYLVANIA*

Arriving at Honolulu last August to take part in the sesquicentennial of the discovery of the Hawaiian Islands by Captain James Cook, R.N. Mr. Dwight F. Davis, then Secretary of War, was the senior United States representative.

International Newsreel

EXIT *MAYFLOWER*

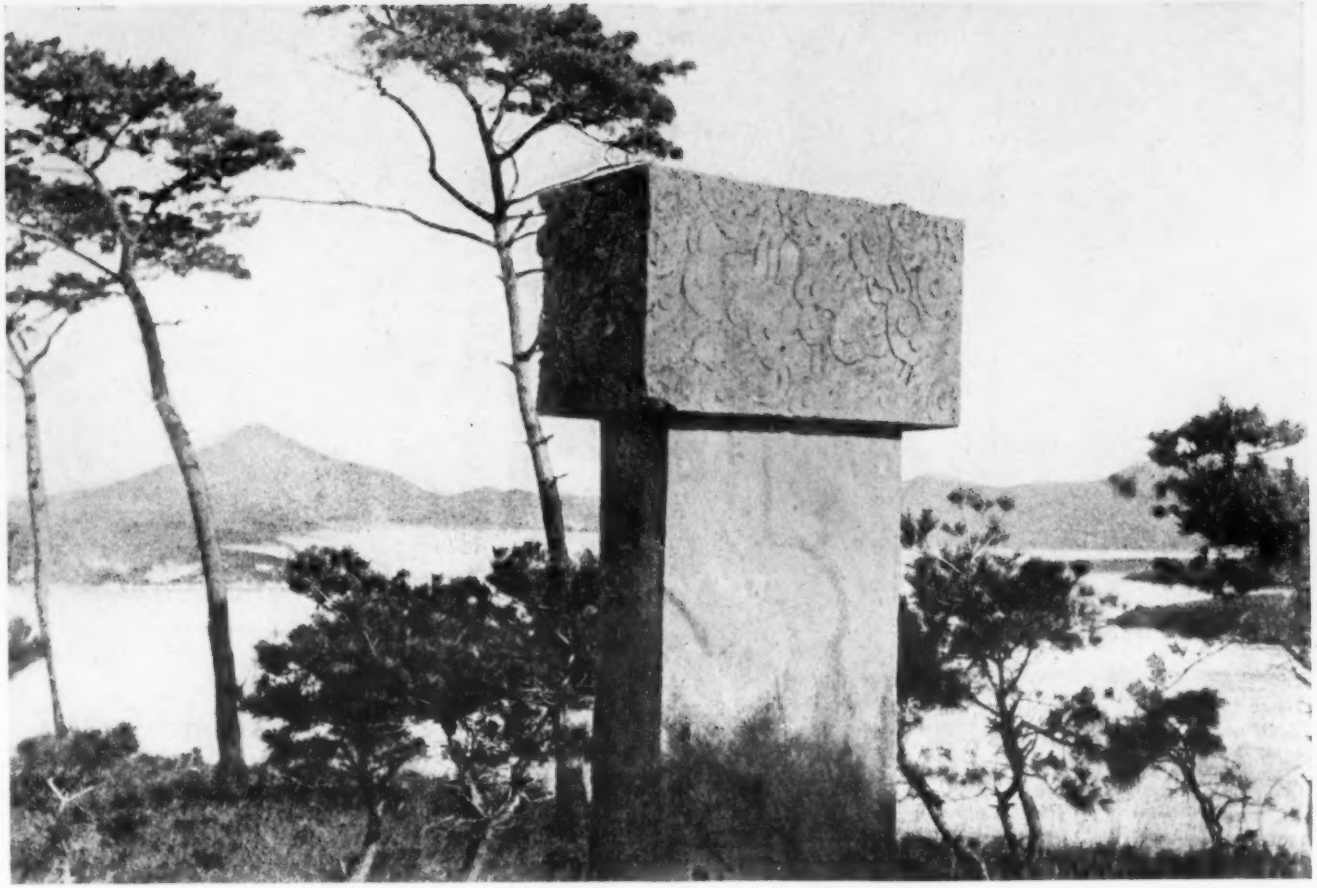
President's flag being lowered for the last time from this historic vessel, which is to be sold.

President's flag being lowered for the last time from this historic vessel, which is to be sold.

International Newsreel

ADMIRAL BRISTOL, U. S. NAVY, IN CHINA

Admiral Bristol will return from China some time in September. He is shown reviewing U. S. bluejackets and marines during the recent revolution in China (October, 1928).



THE TOMB OF ADMIRAL YI SUN-SIN
This tomb is near Fusan, Korea.

The Naval Hero *of* Korea

By LIEUTENANT COMMANDER P. J. SEARLES (CEC), *U. S. Navy*

IN AN obscure corner of the Orient, at a time when Philip of Spain was sending his mighty Armada to conquer England, there lived, fought, and died, one of the greatest naval heroes of all ages. Rising from an unknown origin, and after years of service in minor positions, Yi Sun-Sin, admiral of the fleet, by his genius, inventiveness, energy, and dominating leadership, broke the power of Japan and saved his country, Korea, from destruction. Though his material was peculiar to the time, his methods followed the permanent lines of sound strategy and tactics, and from his struggles can be learned anew the basic principles we need today.

A few words first as to locale and conditions. The scene of operations was the water adjacent to Korea. The sea which separates the island kingdom of Japan from the Asiatic peninsula narrows on the south to a strait divided by the island of Tsushima into two channels of nearly equal width. Tsushima has, for centuries, been the Japanese outpost to the westward. To reach it from the east was always an easy and safe task, but in the fifty-six–mile channel that separates Tsushima from Korea an invading fleet had to run the risk of an attack by Korean warships. Southern and southwestern Korea with its numerous bays, indentations, and islands, offered splendid sites for naval bases, and secure retreats from which ships could dash out for attacks on an invading force.

In Japan, Hideyoshi had risen to power and was virtual ruler of the empire. In China, the Mings, in the person of Wan Li, were on the Throne of Heaven. Korea was oppressed rather than governed by a tyrannical king whose only thought was of licentious pleasures. For many years Hideyoshi had contemplated an invasion of China. The direct route to the Middle Kingdom required a voyage of several hundred miles over seas proverbially tempestuous and dangerous, and even in modern times a leader might hesitate between the ocean route to China and the way through nearby Korea. To Hideyoshi the choice was plain, and he sent a series of envoys to King Chong-Jong of Korea, demanding not only unmolested passage through the land but even military aid. Hideyoshi wrote in the bombastic Oriental style:

> I will assemble a mighty host and, invading the country of the great Ming, I will fill with the hoar frost from my sword the whole sky of the four hundred provinces. Should I carry out this purpose, I hope that Korea will be my vanguard. Let her not fail to do so, for my friendship with your honorable country depends solely upon your conduct when I lead my army against China.

The Koreans were not a military race, and though brave in the face of danger, were poorly equipped and miserably led. On the other hand the Japanese had not only competent generals but also the enormous advantage of firearms. But the Koreans, with a more adequate knowledge of the resources of China, replied that for Hideyoshi to contemplate an invasion was like measuring the ocean in a cockleshell, or like "a bee trying to sting a tortoise through its shell." Hideyoshi, however, was in no way dismayed. "I shall do it," he said, "as easily as a man rolls up a piece of matting and carries it under his arm."

In 1592 the Japanese forces rendezvoused at the islands of Iki. There was a regular army of almost 200,000 men, 80,000 special troops to act as a bodyguard for Hideyoshi (who, however, was prevented by ill health from participating in the invasion), and perhaps 2,000 heavy cavalry. The question of sufficient maritime transport presented some difficulty, but was solved by the expedient of ordering each feudatory bordering on the sea to furnish certain vessels, while crews were obtained by compelling each fishing village to furnish ten sailors for every 100 houses it contained.

This tomb is near Fusan, Korea.

The boats were from forty to fifty feet long, ten feet beam, and carried about sixty men; the first fleet consisted of some 4,000 of these vessels. They were not fighting craft but mere transports, although a few men were distributed among them to repel minor attacks.

The plan of land campaign was in accord with the principles of modern strategy, and so far as this phase of the war was concerned, the armies of Hideyoshi were entirely successful. The general plan was for two thirds of the troops to land in southern Korea and fight a way through to the Chinese frontier. Reserves were to be sent up the west coast of Korea by sea to reenforce the army first landed. A portion was then to remain to guard the land line of communications, while the rest marched into Manchuria. The leading divisions landed at Fusan, May 24, 1592, and were extremely successful in battle. Fusan, Seoul, and Pyong-Yang were all captured in a few weeks, and the Korean forces driven in headlong flight.

But the Japanese soon suffered a severe reverse, one which ultimately was to prove fatal to them; they lost command of the sea. At the outbreak of the war Yi Sun-Sin had command of a flotilla on the west coast of Korea, while the southern coast defenses were entrusted to a second admiral, Wun-Kyun. When a Japanese fleet carrying 60,000 reënforcements arrived at the island of Ka-Dok, off the coast of Kyung-Sang Province, Wun-Kyun, terrified at sight of the vast host, prepared to scuttle his ships and flee by land. But better fortune than this was at hand, for (slightly paraphrasing the words of the old Korean official history, Tong-Guk Tong-Gam), an aide on the staff of Wun-Kyun said to the admiral:

"Do not abandon all hope at once but send and ask Yi Sun-Sin, the admiral of Chul-La, to come and aid you." A swift messenger was sent, and the missive was placed in the hands of Admiral Yi. One of his staff said, "No, let him guard his own coast and we will look after ours. Why should we go and help him?" But Admiral Yi said, "Is not Kyung-Sang province as much the country of our king as Chul-La? How can we refuse to go to his aid?" So eighty boats were gotten ready in haste, and sailed away to the island of Han-Son, where the two admirals met and joined forces.

Admiral Yi thus recognized one of the principles of strategy—the necessity of united rather than dispersed forces.

The united fleet sailed in search of the Japanese, and as soon as the latter were sighted, Yi made a determined attack. The Koreans had the wind astern and were thereby enabled to shoot fire arrows among the enemy. Soon twenty-six ships were aflame; others were rammed, or captured by boarding. The Japanese, astounded at the sudden onslaught, attempted escape by flight, but were overtaken and practically wiped out. This was the first of the great admiral's successes, one which cut off the Japanese armies in Korea from their base. The victory may be said to have been the decisive point in the war.

The complete success of Admiral Yi in this, as in the immediately succeeding engagements, was, in part, due to a peculiar warship of his own design, called kwi-sun or "tortoise boat."[1] The Chinese had previously, in some of their maritime warfare, covered a few of their vessels with decks (or more accurately "roofs") of solid timber, which sheltered the warrior and rowers beneath. The Korean leader improved upon the Chinese model by fastening sheets of metal over the roofs and sides of the turtle-like craft and studding the surface with sharp spikes to discourage boarding. In the bow was a hideous, crested head, erect, with wide open mouth, through which arrows and other missiles could be discharged. There was a somewhat similar opening (whether port or turret is not definitely known) In the stern, and several others on either side. The metal sheathing rendered the ship impervious to fire arrows. In addition to the means of defense, the "tortoise boat" was speedy and could overtake any Japanese vessel afloat. This made her doubly formidable, for even flight did not avail the enemy; she usually did

[1] I have heard somewhere that the remains of one of these odd vessels was seen in 1884 by Lieutenant George C. Foulk, U.S.N., at the village of Ko-Sung, on the coast of Kyung-Sang province, but a search through the letters of Lieutenant Foulk, kindly made by the Navy Department historian, failed to disclose any mention of it. While in Korea a few years ago, I made inquiry as to the vessels, but failed to find any trace of them. Unfortunately my limited time did not allow of a visit to Ko-Sung.

more execution after the flight commenced than before, for she could overtake and ram opponents, one by one, probably better than she could engage them when drawn up in line of battle.

It is odd that the Japanese should have been without any clear perception of the immense fighting superiority possessed by such protected war vessels over small open boats. But certainly they were either ignorant or indifferent. The fleet which they provided to hold command of Korean waters did not include a single ship of any magnitude; it consisted simply of some hundreds of large row boats, manned by 6,000 or 8,000 men. Hideyoshi himself seems to have given the subject some thought, for a few years previously he had endeavored to obtain two galleons from the Portuguese, but without success.

Three other battles followed in rapid succession. In the first, off No-Ryang, Admiral Yi fell in with and defeated a small Japanese squadron, sinking twelve ships. The Korean annals say that "the Japanese in their flight were so terrified by this craft (the tortoise boat), which pursued them and sank them one by one, that they stamped their feet and cried out that it was more than of human workmanship." In this battle Yi received a bullet wound but refused treatment until the enemy had been defeated.

After steering eastward all night, the Koreans approached Tang-Hang[8] where they encountered the Japanese main fleet, which included a three-decked ship, "on which sat the admiral of the fleet, clad in silk and wearing a golden head-piece. The intrepid Yi made straight for this craft with his tortoise boat and when near it called to one of his best marksmen to let fly a shaft at the man in silks. The arrow flew straight to its mark and pierced the man's throat. Seeing the fall of their chief, the whole fleet showed their rudders and made off as fast as they could go, but with the usual result." After a desperate struggle which raged almost all day, the entire Japanese fleet was either sunk, burnt, or captured.

Admiral Yi had followed the sound principle of taking the offensive and destroying the enemy's fighting strength. He soon reaped the benefits of his strategy. Placing himself across the normal line of Japanese sea communications, he fell in with a convoy laden wth supplies and reënforcements for the armies ashore. The Korean fleet maneuvered in a peculiar formation of two long divergent lines, "like a fish trap," as the Koreans say, and surrounded the Japanese. In the resulting battle every enemy ship, twenty-six fighting craft and numerous supply vessels, was destroyed and two hundred heads taken as trophies.

The final sea battle of the first invasion was fought a few months later, while the Japanese land troops were still driving the miserably led Korean armies before them. Yi Sun-Sin, after the previous engagements, apparently considered that the Japanese would be wary of approaching the east coast or of putting in at Fusan, hence he sailed his fleet to its original station on the west coast of the peninsula, where he expected the enemy would next appear. As Ballard says: "Events fully demonstrated the soundness of his judgment, and no strategic move of importance was ever better timed." It is uncertain whether or not Hideyoshi had been informed of the Japanese failure at sea, but with or without this knowledge, he adhered to his original plan of sending reënforcements up the west coast to effect a junction with the land forces. It was a fatal error.

The huge Japanese fleet, with perhaps 100,000 men on board, made for the group of small islands lying off the southwest coast of Korea, and thereby directly entered the Korean trap. When Admiral Yi first sighted the enemy at a considerable distance he feigned a retreat, partly with a view to dispersing the Japanese ships, and partly through apprehension lest a direct attack lead to a Japanese retreat and possible escape. In a short time the Japanese were well strung out in chase. Suddenly altering his course sixteen points, Yi turned on his pursuers and picked them off one by one. Many of the enemy's ships were sunk by ramming, many were burned, and some were captured; seventy-one in all were lost—so the ancient Korean histories tell. A second Japanese fleet arrived during the battle and made a gallant attempt to stem the tide, but to no avail. Over fifty fighting craft were sunk, while the convoy was practically destroyed. Even the courageous Japanese were panic stricken and fled in hopeless rout.

[8] Most of these ports or islands are near Fusan.

With this last encounter, which may well be called the Salamis of Korea, ended the first invasion by Hideyoshi of the Hermit Kingdom. Yi Sun-Sin by his astounding success at sea had frustrated the prime motive of the invasion—the humbling of China—and although the land war dragged on for a time, the Japanese by attrition were obliged to retreat to the neighborhood of Fusan.

The Shogun, while rebuffed, was not daunted and at once set about preparing a new invasion. For three years ships were built and troops and supplies recruited. At last, in 1596, he again was ready. But once more Hideyoshi blundered. During the first invasion he had overlooked the influence of sea power, while prior to the second invasion he underestimated the strength of the Korean armies which had been reënforced by hordes of Chinese, and which were now led by the foremost generals of the Mings. Space does not permit telling of the land war beyond the statement that the Japanese were, generally speaking, unsuccessful.

In order to remove the menace of Yi Sun-Sin, the wily Hideyoshi prepared a stratagem which is told best in the words of the Korean historians:

> But before making this second descent upon the shores of Korea it was necessary for the Japanese to get the redoubtable Admiral Yi Sun-Sin out of the way. No fleet from Japan would risk an encounter with him in his "tortoise boat." The Japanese had seen how the mutual jealousies of the Koreans worked in their favor and they determined to use this in getting Admiral Yi removed. So one day a Japanese named Yo-Si-Ra made his appearance at the camp of General Kim Eung-Su, saying that he was tired of being a Japanese and that he wanted to become a Korean. He dressed in Korean clothes and kept going back and forth between the Japanese and Koreans, giving the latter what seemed to be much valuable information. He seemed to be devoted to the Korean interests. One day he came in a state of great excitement and said that the Japanese General Kato was coming to Korea with a great fleet and that, as he was to pass a certain island off the coast, Admiral Yi ought to be sent to lie in wait there and drive the invading fleet back or to sink it. So General Kim wrote to the king about it and asked for orders. The king, trusting to the prowess of Admiral Yi, gave his consent; but when that officer received these orders he promptly replied that it was a trick to entrap him and thus clear a way for a descent upon the mainland of Korea. He therefore declined to run the risk, especially as the place mentioned was studded with sunken rocks and was specially dangerous for navigation. But the Japanese Yo-Si-Ra kept urging General Kim to see to it that the plan was carried out and at last the general wrote to the king saying that Admiral Yi declined to go. As may be supposed Admiral Yi had enemies at court who could not let such an opportunity pass of getting him into trouble. Consequently the iniquitous decree went forth that Admiral Yi be seized and brought to Seoul and that Wun Kyun be put in his place. The king intended to put Admiral Yi to death, but one of the officials urged his former services in palliation of his present offense and so the punishment was commuted to loss of position alone. So it was that Admiral Yi, the best soldier that Korea contained and to whom the king owed his crown twice over, was degraded to the ranks and became a common soldier. But most remarkable of all, he made no complaint, but went quietly about his work as if nothing had happened."*

In the early part of 1597, 1,000 Japanese ships carrying an enormous army put into So-Sang, and the invasion started anew. The new Korean admiral, Wun Kyun, fled before the invaders, and in a safe camp inland spent his time in his harem. But the Japanese spy urged General Kim to send out a fleet to intercept the Japanese, even naming a day on which the Koreans would be certain of finding the enemy. Wun Kyun was averse to the enterprise but could not well demur as it was the refusal to carry out the same maneuver that had cost Yi his position. After some delay Wun Kyun sailed for Chul-Yung, but his ships were dispersed by a sudden storm. Before the ships were completely assembled again, a Japanese fleet appeared and routed the Koreans with great loss.

> Almost immediately all Admiral Wun's forces deserted him and his only recourse was to flight. Beaching his boats on Ch'il-Ch'un island he landed and drew about him what remnants of his force he could find. When General Kwun Ryul heard of this he sent a stern order demanding that the admiral come out and fight. That valiant man first filled himself with wine, then sallied forth only to be deserted again by his men. So the doughty admiral again ran his boat aground and took to his heels. He was so fat however that he could not run far so he sat down under a tree to get his breath. There the Japanese overtook him and carried away his head in triumph.

This was the first great naval victory gained by the Japanese over a foreign enemy.

When news of the disaster at sea reached the Korean court, the King reinstated Admiral Yi Sun-Sin, and called on him to sweep the waters clean of the enemy. Yi

*The above story is complicated by court intrigue and corruption, too lengthy to detail, but presenting a sordid picture.

collected the scattered fragments of the fleet and reformed them for aggressive action. Before he was ready, however, the Japanese had landed a large army and for a time were victorious against the Chinese-Korean forces. In a signal victory, the invaders collected the ears and noses of 37,000 Koreans and Chinese, which were sent to Japan as trophies and buried under a tumulus near the temple of Daibutsu in Kyoto.[4]

By the latter part of 1597, Admiral Yi had collected a few small boats of the "tortoise" design, and, with picked crews, set to sea. He came into immediate contact with the Japanese, first by a night attack on a small convoy, and the following day by meeting a much larger force. The Korean admiral fearlessly headed for the enemy and by his valor and leadership annihilated the opposing fleet. Yi, by this victory, won a short respite, during which he built more ships, replenished supplies, and recruited and trained crews. In the meantime the Emperor of China, who was becoming more fearful of the threatened loss of Korea (which was, at least theoretically, a feudatory of China), sent two admirals to command all naval forces. One admiral, Tong Il-Wun, was to direct operations off the coast of Chul-La, and the other, Chil Lin, off the coast of Kyung-Sang. The latter was appointed "Great Admiral" by the Korean ruler, and as he was inordinately vain of his title and position, many expected difficulties to arise between him and Yi. To add to the troubled atmosphere, certain disgruntled courtiers expressed to Chil Lin fear of Admiral Yi's loyalty.

But Yi soon showed that he was as good a diplomat as he was a warrior. As the Korean chronicles state:

> He collected a great store of game and fish and wine and went out to meet the approaching admiral with his fleet. Returning with the Chinese admiral he spread a great feast and the whole company got splendidly drunk and vowed that Admiral Yi was a royal good fellow. Admiral Chil Lin himself joined in the praise. Soon after this Admiral Yi had the good luck to take two score of Japanese heads, but instead of claiming the honor himself, he handed them over to the Chineses admiral to forward as his own trophies. This finished Admiral Yi's conquest of Admiral Chil Lin's good graces. From this time on it was Yi who suggested and planned and it was Chil Lin who assented and reaped the praise.

This course of conduct was a stroke of genius on the part of Yi Sun-Sin, for by it he accomplished three things. He kept his own position which he would have lost if he had antagonized the Chinese; he was able to give his services to Korea when she most needed them; and by such flattery he so encouraged the Chinese that they sent men, ships, and supplies, far beyond what was originally intended. Yi was willing to give Lin all the praise and glory, whereas in reality he had the Chinese admiral, as the pregnant Korean phrase goes, "in his sleeve." Yi soon was given control of the entire fleet, and succeeded in welding it into a harmonious unit. Chil Lin was loud in his commendation of Yi as a subordinate, and wrote the Emperor of China that "the universe did not contain another man who could perform the feats that Admiral Yi found so easy."

For many months the Japanese were helpless at sea, losing ship after ship. Their only success came on one occasion when Chil Lin, fired to unexpected action, attempted to attack the fortress of Sun-Ch'un, and, knowing nothing of currents or tides, found himself high and dry on the beach. The Japanese trooped out and destroyed forty-eight of the stranded vessels; Chil Lin himself escaped. Desultory land fighting continued, but as the Japanese could receive no reënforcements with which to meet the ever-increasing hordes of Chinese, they were gradually driven southward to the vicinity of Fusan. General Yu Chung, commanding the Korean troops, persuaded the only too-willing Japanese leader, Kato, to evacuate, but when the latter put to sea he encountered Chil Lin, still smarting over his recent defeat, and was driven back with considerable loss. Kato, in a trap, determined to bribe Chil Lin and sent him a "slight testimonial of regard" in the shape of one hundred ounces of silver and forty-five swords, in return for which the Chinese admiral was to allow the Japanese to sail safely away. But the invaders had reckoned once more without Yi, who refused all bribes or offers, of peace. The doughty patriot was determined to exact vengeance for the rape of his native land.

The Japanese decided to try and slip by their redoubtable enemy in the early morning, but Yi learned of their intention and before daybreak massed his ships and headed for the Japanese fleet. It is said

[4] This bloody memorial, called Mimizuka, or Mound of Ears, can still be seen in Kyoto.

that as he approached the enemy he uttered the following prayer to his god: "Today I am to die. Give me but one more victory over these Japanese and I shall die content." The old accounts indicate that Yi was under no illusion as to his standing at court, where envious and traitorous courtiers were plotting his downfall and death. He knew that further success would only increase his peril, and that to fall in battle was his only way of escaping the executioner.

The fighting was short but fierce. Once again Yi used his old tactics of two divergent lines enclosing the enemy and crushing them as in a nut cracker. His own "tortoise boats" were well-nigh invulnerable, and within an hour or so he had destroyed over fifty of the Japanese ships. Two thousand heads were taken as trophies. The sea was covered with boats frantically endeavoring to escape, but one by one they were overhauled and sunk by the relentless admiral, who had sworn to annihilate the enemy.

During the struggle, news reached Yi that a fresh Japanese fleet had attacked Chil Lin. Dashing to the defense of the Chinese leader, Yi again came into conflict with the desperate enemy. But this time he changed his tactics. Instead of ramming or engaging in hand-to-hand combat with the Japanese, he circled round and round their fleet, driving them closer and closer together. When the vessels were in a huddled mass, the Koreans introduced a new weapon, alleged to be Yi's own invention, called the *pun-t'ong* or "spraying tube." The exact nature of this weapon or how it was used is not known today, but it apparently was an adaptation of Greek fire or the ancestor of liquid flame. In any event it sufficed to set the Japanese fleet on fire. A wind sprang up to fan the flames and soon the Japanese fleet was a blazing mass. Hundreds of boats were consumed with all their crews. A few escaped from the flames but were hunted down and sunk without mercy.

The victory was one of the most glorious in the history of Korea, but in gaining it the country suffered the loss of Admiral Yi, a loss they could ill afford. Standing on the prow of his boat in an exposed position, urging on the chase, he was struck by a bullet and fell mortally wounded. His last words were, "Do not let the rest know that I am dead for it may lose the battle."

But the life work of the valiant and patriotic admiral had been completed. The Japanese invasion was at an end, and for centuries Korea was not again molested from beyond the seas. Yi Sun-Sin was the one bright light in a land of treachery, incompetence, and sloth. Beset by foreign enemies at sea and by a vicious court on land, he devoted his life to struggling against the invaders, and succeeded in saving his native land. As a strategist Yi was without a peer in the Orient of his time, for he alone realized how essential to Korea was command of the sea. He envisaged the fundamental factor of offense so indispensable to victory. Single-hearted, he gave his entire energy to building a fleet capable of closing the straits of Tsushima to the enemy, knowing that without reënforcements the Japanese armies ashore would slowly but surely be defeated. Yi's mechanical inventions, particularly the "tortoise boats," in the hands of a crew well disciplined and raised to a high pitch of morale, were the weapons, and these combined with his firm grasp of strategical and tactical principles, his masterly formations, his seamanship, and his indomitable spirit, invariably brought victory to his banners.

For epitaph to this Nelson of the Orient, we can do no better than quote the words of Chil Lin, who, on seeing the Korean hero dead, exclaimed, "I thought that he would save me and still live, but here he lies dead and there is no soldier now left in Korea."

Postgraduate Instruction

By LIEUTENANT A. M. GRANUM, *U. S. Navy*

THE necessity for specialized training for officers, beyond the fundamental education received at the Naval Academy, probably is not now seriously questioned by anyone. In practically every department on board ship an officer requires a comprehensive understanding of the fundamentals of engineering, and in many cases is faced with complex problems which call for expert treatment. The need for special training is great in the operating field. It is essential if real progress is to be made in improved methods and design. What is said of engineering applies with equal force to other fields. Just as intricate problems present themselves in administration, law, and command. Each is merely a part of the great problem of the conduct of war.

While the need for specialized training has always existed it has not always been so well recognized as it is today. As early as 1871 the rank of cadet engineer was created, showing a recognition of the need for specialized engineering knowledge, and establishing an engineer corps to supply that need. Later, in 1899, when it was seen that a good knowledge of engineering practices was an essential equipment of every line officer, the engineer corps, as such, was abolished, and amalgamated with the line. Perhaps the first step toward postgraduate instruction, as we think of it today, was the application of Cadet Engineer Francis T. Bowles for a course in naval architecture. After some difficulty he obtained for himself and Cadet Engineer Richard Gatewood, appointments as assistant naval constructors and permission to go to the Royal Naval College at Greenwich, England, to take the course in naval architecture there. Naval constructors were first sent to Massachusetts Institute of Technology in 1903.

A school of marine engineering was established at the Naval Academy in 1909. The instruction was largely informal. Students selected specialties and consulted a technical library for information. It was found that they were greatly handicapped by lack of knowledge of mathematics and the fundamental sciences. The need for more instruction and a carefully planned curriculum was soon recognized. Accordingly, in 1912, the title of the school was changed to "Postgraduate Department" of the Naval Academy. The scope was enlarged to include postgraduate instruction for naval constructors, civil, ordnance, electrical, and radio engineers. Its first head was Captain J. P. Morton, U. S. Navy. It occupied rooms in Isherwood Hall, the steam-engineering building at the Naval Academy.

Work of the Postgraduate School was necessarily suspended during the World War. In 1919 the school was reopened, the old marine barracks at the Naval Academy being remodeled for the purpose. Location of the Postgraduate School at the Naval Academy makes available the facilities of the Engineering Experiment Station and of the Naval Academy itself. It places the Postgraduate School in close proximity to the various bureaus of the Navy Department, the Proving Grounds, Naval Gun Factory, Naval Research Laboratory and various scientific institutions in Washington. The Postgraduate School itself has well-equipped laboratories for experiments in general physics, engineering measurements, chemistry, heat physics, optics, hydraulics, thermodynamics, metallography, internal-combustion engines, electrical measurements and tests, radio, and tests of materials. Textbooks are furnished to the student officers and the library contains excellent references, including the current technical and scientific papers.

The requirements for entering the Postgraduate School are given in the *Bureau of Navigation Manual.* For the class entering in July, 1928, there were applications and selections as follows:

Course	*Applied*	*Selected*
General Line	111	60
Ordnance	54	8
Aërology	16	4
Mechanical Engineers	49	22
Aëronautical Engineers	27	3
Communication Engineers	29	15
Electrical Engineers	26	14
Diesel Engineers	19	13
Naval Constructors	23	6
Civil Engineers	21	3
Aviation Ordnance	7	2
Compass Design	8	4
Law	45	4
Total	435	158

The present size of the school is considered sufficient to meet the needs of the Navy. If expansion is to be made the Bureau of Navigation hopes to make it in the direction of a greater general line course. The appropriation for the Postgraduate School for the past fiscal year was $150,000.

Except in law the first year of all postgraduate instruction is spent at the Postgraduate School at the Naval Academy. The general plan provides that the first nine months shall be devoted to a basic course, taken, with minor exceptions, by all students. This does not apply, however, to officers taking the general line course, as they pursue a separate line of study throughout. The fourth term of the first year's work is a specializing term. The different groups then are divided up and take work applying more directly to their respective specialties. There follows one or two years further of specialized work, usually at some civil school, supplemented during the summers by practical work at navy yards or stations and at various industrial plants.

New classes start work at the Postgraduate School about July 1 each year. Officers find themselves faced with a program of classroom exercises, laboratory work, and study which requires an estimated expenditure of time of fifty-eight hours per week. These include fourteen hours of classroom exercises, twelve and a half hours of practical work, one hour lecture, five hours of athletics and twenty-five and a half hours' estimated time for preparation. The lectures are usually given on Saturday mornings during the fall and winter terms. The lectures ordinarily cover subjects of broad professional interest. They are given by officers and civilians who are authorities in their respective fields. The athletic periods are to be devoted to some form of strenuous exercise, outdoor whenever practicable. Baseball, tennis, basketball, soccer, indoor baseball, golf, swimming, and volley ball are accepted forms of exercise.

The basic course to which the first three terms—nine months—are devoted, gives training in and provides for study of the fundamentals common to all engineering subjects. These include mathematics, mechanics, physics, electricity, engineering measurements, hydraulics, engineering materials, thermodynamics, metals, and chemistry. In the third term the communication engineers take courses in alternating current circuits and sound instead of chemistry or thermodynamics. The aërological engineers do not take metals or engineering materials in the second term, or metals or electricity in the third term. They substitute for these subjects a course in German, since German texts are used in some of their later work. Their thermodynamics in the third term is slightly different from that of other groups. Particular attention is given to the properties of gas mixtures, and of gas and vapor mixtures such as the atmosphere, instead of to the working cycles of the steam plant.

The above outline is taken from a syllabus of the courses prepared by the head of the Postgraduate School. Much of the other material herein submitted is derived from the same source.

In the fourth term the groups are more definitely separated and given work along the lines of their particular specialties. This term prepares the student officers for the specialized work of the following year and gives them an introduction to such study.

The mechanical, electrical, and Diesel engineers all take the same work during this term, as their subsequent courses at Columbia are similar in many respects. The subjects taken are mathematics, mechanics, electricity, thermodynamics, and metals. The mathematics is a continuation of the study of the first three terms, with additional work on integrals in several variables, treatment of empirical data and solutions of systems of differential equations with applications in electricity and mechanics. An introduction to partial differentiation is given. Mathematics is stressed in all courses, as it is the basis of any form of engineering. The text used throughout is Professor R. E.

Root's *Mathematics of Engineering*. It was prepared especially for the officers at the Postgraduate School, but it has found favor in other engineering schools.

In this term the Columbia group stresses the mechanics of engines, including engine balancing, forces affecting bearing pressure and friction losses in engines of standard types, and study of free and forced vibrations and resonance of elastic bodies, with particular reference to torsional and transverse vibrations of a rotating shaft under variously assumed loading. The applications of thermodynamics to steam engines and turbines, combustion, boilers and furnaces, internal-combustion engines, air compressors, refrigeration, heat transmission, and air conditioning are studied. The course in electricity pays particular attention to the fundamentals of alternating-current circuits and machinery. In metallurgy a special course is given in preparation for more advanced work in metallurgy and metallography during the second year. Alloys are taken up in a general way, with a more thorough study of the metallography and heat treatment of iron and steel. One group makes a special study of storage batteries.

Mathematics for the communication engineers includes a study of hyperbolic functions, differential equations, vector analysis, and electric oscillations and electric waves, all of which come up during the work of the second year. Their electricity is similar to that of the Columbia group, but with emphasis more particularly on the power systems and circuits required for large radio stations. They make a study of the elements of radio, including vacuum tubes, radio circuits and measurements at high frequency.

In the mathematics for the aëronautical engineers the applications of special topics, such as conformal transformations, potential and stream functions, vortices, line integrals, etc., to the problems of air flow in two and three dimensions and to the determination of the air forces on monoplanes, biplanes, and propellers are studied. Their mechanics is the same as that for the mechanical engineers. They make special studies in internal-combustion engines, engineering materials, metallurgy, and chemistry. The chemistry deals with motor fuels and lubricants.

The naval constructors take the same course in thermodynamics and electricity as the Columbia group. They have advanced work in mathematics and take an introductory course in the speed and power of ships. An inspection trip is made to the model basin in the Washington Navy Yard. One group specializing in airplane design is given a course in engineering materials with particular emphasis on structure and design of airplanes.

Civil engineers are given introductory courses in railroad curves, surveying and structural engineering, and a general course in electrical engineering, such as applies particularly to stationary power plants.

The aërologists continue study of German, and start reading German texts on meteorology and thermodynamics of the air. They take courses in physics of the air, weather-map drawing, oceanography, and collateral reading. They continue with advanced work in mathematics.

Ordnance engineers specializing in explosives, torpedo design, and metallurgy are given work to prepare them for the following year at civil universities. Those interested in explosives take advanced work in mathematics, a course in mechanics with emphasis on elastic strength of guns and exterior ballistics, and qualitative chemical analysis with a view to preparing for courses in quantitative and physical chemistry. They take the same course in electricity as the Columbia group. The metallurgists study mechanics, including elastic strength of guns, and exterior ballistics, electricity, qualitative chemical analysis, and an intensive course in ordnance metallurgy. Much collateral reading of Navy ordnance pamphlets is required. The officers specializing in torpedo design follow the same courses in mathematics and mechanics as the explosives group. They take the same work in thermodynamics as the Columbia group. Special courses are given in electricity with emphasis on the characteristics and phenomena of direct-current machinery, and in kinematics.

For some years it was the practice to divide the ordnance class into six subdivisions, specializing in explosives, metallurgy, torpedo design, ordnance design, fire control and ballistics. In 1926 the Postgraduate School was informed by the Bureau of Ordnance that the best interests of that bureau were not served by such minute specialization. On account of the technical knowl-

edge required for explosives, metallurgy and torpedo design it was decided that the existing practice should be continued for those groups. The remaining groups were amalgamated into a general ordnance class.

No educational institution offers courses that meet the special character of the needs of this general ordnance class. Accordingly there has been designed a course for the second year at the Postgraduate School which embraces all the subjects deemed necessary to qualify an officer for duties in ordnance design, fire control, and ballistics which he may be called on to perform under the Bureau of Ordnance. Further, it is believed that this course will make an officer a far more valuable gunnery man at sea. It has been the aim of the school to give the faculty members specially concerned direct contact with ordnance designers and operating personnel. To this end conferences have been arranged between members of the faculty and officers, designers and engineers in the bureau, the gun factory, Dahlgren, Indian Head and the Army Proving Ground at Aberdeen, Maryland. It is hoped to establish regular contact with forces afloat by giving one or more faculty members a month's instruction at sea, preferably on a ship whose gunnery officer has had postgraduate instruction. The opportunity they would thus have to observe ordnance and fire-control material and operation during target practice would be of great value in giving them a practical background. The faculty have coöperated fully in the aims of the Bureau of Ordnance and of the head of the Postgraduate School.

The new course gives instruction in the old standard methods in exterior ballistics as presented by Alger, Cranz, and Herrmann, as well as the more modern methods of numerical integration, and in the stability of projectiles in flight. The Le Duc formulas, the Ingalls methods and the method of numerical integration as applied by Bennett are covered in the work on interior ballistics. All the desirable features of the old course in ordnance design and all of the work in fire control have been retained and amplified. The work in metallurgy compares favorably with that done by those specializing in this subject. All in all a very satisfactory course has been designed. An officer who completes it satisfactorily goes out well equipped to handle any general ordnance problem with which he may be confronted.

For the general ordnance group the work of the specializing term includes mathematics, mechanics, electricity, kinematics and mechanism of machines, optics, and ordnance equipment. The summer course following the first year's work consists of three months' practical instruction in the design section of the gun factory, Navy Yard, Washington, D.C. During the second year at the Postgraduate School this group goes on with advanced work in the subjects taken during the specializing term and in addition takes up a study of metallurgy, and structures and materials. The third year is spent in practical instruction at navy yards and industrial plants such as, for example, the proving ground, powder factory, gun factory and optical shop, Ford Instrument Co., Sperry Gyroscope Co., General Electric Co., Navy Yard, New York, Aberdeen, Edgewood, and the Bureau of Ordnance.

For most of the groups the second year's work is taken at civil universities selected by the Department. Tuition for the officers is paid out of funds allotted. Books are furnished by the Postgraduate School. Where universities offer courses which meet the requirements of the several specialties there are many advantages in sending officers to such schools. The courses are given by professors who have made notable contributions in their specialties and are recognized authorities. The laboratory equipment in most cases is of the best, and designed to give the students thorough training in applying the principles expounded in the lecture room. These universities are generally located near industrial plants which may be visited in connection with the work. Methods and practices can be observed which are different from those in use in the Navy, but which may have possible application therein. Contacts are made with prominent civilians from all over the country, and from foreign countries. This gives the officers an opportunity to promote popular knowledge of, and interest in, the Navy. Officers from the Postgraduate School are cordially received by the universities, and it is believed that their work compares very favorably with that of other graduate students.

Columbia, with extensive facilities, and in

close proximity to numerous power and manufacturing plants, has most to offer the mechanical, electrical, and Diesel engineers. All three of these groups take courses in metallurgy and metallography, electric-motor control, and in experimental procedure. The mechanical and Diesel engineers have the same courses in heat transfer, machine design, thermodynamics, high-speed gasoline engines, and oil engines. The mechanical engineers take one course in steam turbines, while the Diesel engineers spend more time on oil engines. The electrical engineers take courses in technical alternating current, in direct-current design, electrical plants, and design of electrical propulsion machinery. They also have some work in radio. A storage-battery course is given, with stress laid on physical and electrochemistry.

In all of the work at Columbia the laboratory plays a very important part. A great deal of problem work is given. A degree of master of science in engineering is given if the courses are completed with high credit.

The school longest associated with our postgraduate instruction is the Massachusetts Institute of Technology. There have all our naval constructors received their training since 1903. They have had the particular inspiration of Professor William Hovgaard. Professor Hovgaard was a Danish naval officer. He graduated from the Royal Naval College at Greenwich, England, in the same class with Bowles and Gatewood. This man, of slight figure and unpretentious mien, has had a profound influence on ship design and construction in the Navy of his adopted country. Our men may go to sea with every confidence in their ships.

The naval constructors spend two years at Massachusetts Institute of Technology with a program of intensive study. During the first year the courses include alternating currents and machinery, business law, internal-combustion engines, marine engineering, merchant shipbuilding, model making, naval architecture, political economy, shipyard practice, steam turbines and warship design. A shop-practice course during the summer preceding is followed by three weeks at the General Electric works at Schenectady, New York. Warship design is the major course during the second year. Other subjects studied are naval architecture, rigid dynamics, structures and structural design, and precision of measurements. A short course in aëronautics is given. A satisfactory thesis is required for a degree of master of science in naval architecture.

One group of naval constructors specializes in airplane design. Their course is altered to include airplane design, airplane structures, propellers and airships, aëronautical laboratory, and airplane-engine design.

A new course in aëronautical engineering at Massachusetts Institute of Technology may require some revision later. At present it includes one year of work in airplane design, automotive fuel problems, dynamics of engines, aircraft metallurgy and metallography, heat treatment, machine design, airplane-engine design, and aërial propellers. A thesis is required for a degree of master of science in engineering.

With undoubtedly the most complete equipment of any school in this country for instruction in shop-work and engineering practices, Massachusetts Institute of Technology is equipped to give our torpedo designers the best possible preparation for their later duties. They take courses in automatic machinery, dynamics of machines, machine design, mechanism of machines, materials of engineering, heat engineering, heat treatment, metallography, physical chemistry, theory of the gyroscope, thermodynamics, and torpedoes. This covers one year's work. They are given a research of 300 hours to perform between June 15 and December 15 of the following year.

All the above courses at the Massachusetts Institute of Technology are preceded by a summer of practical work in the laboratories and shops of the school.

The ordnance metallurgists take their second year's work at the Carnegie Institute of Technology, which is believed to give the best course obtainable for this specialty. The subjects included are general metallurgy, non-ferrous metallography, physical chemistry, and electro-chemistry. There is a special study of aluminum and its alloys, and special metallurgical problems.

At the University of Michigan the explosives engineers study organic chemistry, physical chemistry, unit processes, utilization of fuels, material balances, chemical technology of the organic and inorganic industries, and explosives and pyrotechnics.

The aërologists divide the time during their second year between Massachusetts Institute of Technology and Harvard. This year they are taking at the former institution *Dynamische Meterologie*, using a German text by Exner, physics of the air, weather forecasting, and research problems as found practicable. At Harvard they are taking a course in climatology under Professor Ward. They are given a program of collateral reading. Last year they were conferred degrees of master of science in engineering by Harvard University.

Communication engineers are divided for their second year's work between Harvard and Yale. At Harvard more attention is paid to the mathematics and theory of radio, while at Yale the practical side is stressed. At the latter school our officers come in contact with officers from the Army who go to Yale for postgraduate work in communications. Professor G. W. Pierce, at Harvard, was prominent among the group of scientists and engineers interested in the problem of submarine detection during the World War. Much of our present-day under-water sound equipment is due to his work. Like most of the professors with whom the postgraduate has to deal, he maintains a sympathetic and helpful interest in the aims and problems of the Navy.

At Harvard courses are given in electric oscillations and electric waves with their applications to radio telegraphy and radio telephony, electron tubes, hydrophone engineering, and special problems in communication engineering. A degree of master of science in communication engineering is conferred if the work is completed with an average grade of B—about 90 per cent.

The courses at Yale include mathematical theory of sound, transient phenomena, electron theory, high-frequency measurement, hydrophone engineering and wave propagation, and filter design. A language qualification, French or German, and a thesis are required for a degree.

The civil engineers spend two years at Rensselaer Polytechnic Institute, Troy, New York. This school was established in 1824 and has been in continuous existence longer than any other purely scientific and engineering school in English-speaking countries. During this first year the civil engineers receive instruction in bridges, electrical engineering and power distribution, material testing, railroad engineering, power plants, machine construction, building construction, waterworks and sewers, concrete highways, paints, oil and varnishes. Upon successful completion of their courses and submission of a satisfactory thesis they are given a degree of civil engineer. The second year includes work in geology, graphics, heating, ventilating and refrigeration, power plants, electro-metallurgy, communication engineering, retaining walls, dams and docks, business administration, and the writing of specifications. They are required to write a satisfactory thesis for degree of master of science in civil engineering.

During their first summer this group makes a surveying trip under supervision of the school. The second summer is spent at some large power plant, such as the Brooklyn Edison Company, Brooklyn, New York.

The summer practical work is an important part of the course for all groups. Officers are required to keep notebooks of their activities during these periods. These notebooks, when carefully kept, become a file of useful information for later reference.

The summer program for some of the groups has already been described. Most of the first summer for the Columbia and Massachusetts Institute of Technology groups is spent in practical instruction at these schools. The second summer is spent at navy yards and the important industrial plants concerned with manufacture of Navy material. The latter include such firms as General Electric Co., Worthington Co., and the Pratt and Whitney Co., (for aviators).

The communication engineers spend the first summer in the Office of Naval Communications and with the Bureau of Engineering. Under the Bureau of Engineering they receive instruction at the Naval Research Laboratory, the radio test shop of the Washington Navy Yard, and at the high-power radio stations at Arlington and Annapolis. The second summer includes visits to the Submarine Base, New London, Connecticut, Fort Wright, General Electric Co., Bell Telephone Co., etc. The last two months are spent in the office of naval communications, studying confidential publications and hearing lectures on all phases of their work.

The aërologists spend some time at Lakehurst during the second summer. During

the past summer (1928) two officers taking petroleum engineering made an extended inspection tour of oil fields in the United States.

The general line course has been considered by the Bureau of Navigation since 1919, when it was first officially recommended. For some time it was held up by a shortage of officers. The aim is to give valuable training and education along lines that are important but for which an officer has too little time to spare from his regular duties. It will qualify an officer for many billets now held by those with more technical training, and should supply the experts in operation and administration. A proposed course for 1928-1929 includes instruction in tactical maneuvering, navigation, electricity, radio, ordnance and gunnery, military law, information and policy, economics, mechanical engineering, United States diplomatic history and foreign relations, government, communications, coding and decoding, naval aviation, supplies afloat and ashore, stability, damage control, and seamanship. The second year is spent at the Naval War College, Newport, Rhode Island.

Postgraduate work in law is taken in two years at George Washington University, during which time officers are attached to the office of the judge advocate general of the Navy.

The foregoing is a survey of the present-day scope and work of the Postgraduate School. It is recognized that details of the courses require modification from time to time.

Quoting from a recent address delivered at the Postgraduate School by Rear Admiral R. H. Leigh, chief of the Bureau of Navigation, a final point of equal importance to all postgraduates is this: "After leaving the Naval Academy it is my belief that the mind of each officer needs to be sharpened up and refreshed after five or ten years' service up to the time he is forty-five or fifty years of age. Aside from his own personal reading and study any well-regulated course serves to stimulate his ambition, refresh his mind and contribute to his ideas and imagination. Without this, and with personal, individual study alone, it is the more modern belief in the system of education and training that the most successful results cannot be obtained—either in naval, military, or in civil life."

Rear Admiral Leigh says further: "Graduates of the Postgraduate School have already made efficient contribution in the design and production fields of engineering and ordnance which the service might not have had without this school. The subject of personnel and its importance is recognized by all of us. The Navy cannot overlook the part which invention, research, and modern production as directed by naval-officer specialties has played in the increased efficiency of the present Navy today. It is believed that the officer who has had the dual experience of furnishing and handling both material and personnel can better understand the demands and problems of each."

Officers of the line taking up postgraduate work are reminded by the Bureau of Navigation that they will nevertheless be required to assume the responsibilities of command. Many of the best officers in the higher grades in the Navy have been specialists or have spent considerable time in engineering or other technical branches of the service. The need for specialists is great and the Bureau of Navigation appreciates the work and ambition of those who desire to fit themselves as such. It desires them to feel that they may do so without prejudice to their opportunity for higher command. To this end it is the aim of the bureau to arrange details of duty to permit every officer to progressively fit himself for the responsibilities of command. The mental discipline and the experience received through postgraduate work and the application to a specialty are assets which will benefit the officer in later years.

Special Characteristics *of the Ersatz Preussen*

By CAPTAIN H. C. DINGER, *U. S. Navy*

THE alleged characteristics of the German battleship *Ersatz Preussen* have been published. There has been much comment in the press as to this wonder ship, which is to cause consternation in all the navies and is heralded as almost the work of magic. An examination of the alleged characteristics from a dispassionate technical angle fails to show anything magical about the vessel, but it does appear to indicate that the German Admiralty have permitted their engineers to produce, without undue technical or financial restrictions, what their engineering talent is able to, by utilizing materials, processes, and methods that are available to them. Somewhat similar results might be produced in other countries under like conditions.

The battery of six 11-inch guns and eight 6-inch guns is not inconsistent for a small battleship. By reducing the power to one-half that of the 10,000-ton light cruisers, 1,000 tons of weight have been saved that can be put into a heavier battery and increased armor. This battery does not weigh in excess of 50 per cent above that on our 10,000-ton cruisers.

The reports allege that the hull is entirely welded. This is more or less doubtful, but no doubt welding is used very extensively. This is entirely sound practice and can, also, be done in this country. By the substitution of welding in lieu of riveting, and welded structures in lieu of heavy castings, a saving of weight of eight hundred tons can readily be made in the hull and machinery of a 10,000-ton vessel.

There is nothing to prevent the U. S. Navy, or the English or French Navies, using welding as extensively as it has been used in this German vessel. United States' welding technique is, I believe, fully up to that employed in Germany. United States' industry is using it very extensively. All that stands in the way of using it much more than we have heretofore in naval construction is a certain excess of conservatism. However, we have some welded turbine casings already in service in our Navy and more are likely to come. We are on the eve of having welded boiler drums.

The Diesel engines are said to weigh only seventeen pounds per horse power. This is less than half the weight of the large Diesels being built for United States submarines. This weight, I take it, refers to the Diesel engines alone and not the total machinery weight. The total machinery weight would be about twice this, or thirty-four pounds per horse power, or about the same as our light cruiser machinery. This saving of weight has been secured probably by substituting aluminum and other lightweight alloys (possibly magnesium) for steel and iron. Our automobile engines and aircraft engines have been doing this for years. It is expensive, but in aircraft engines we have gotten below 1.5 pounds of engine weight per horse power. Diesel engines for aircraft weighing about three pounds per horse power are being built. If the engines are double-acting, weight would be saved by this expedient. It is also likely that the engine units consist of several cylinder groups connected to a shaft by reduction gear. This enables high-speed engines to be employed, tends to save weight, and provides for engines that can be placed below the protective deck.

Whether these Diesel engines will be as reliable as turbo-reduction gear remains to be seen. It is possible, but from past experience with Diesel engines, either German or otherwise, it is doubtful.

The power of the German ship is less than one-half that of the fast 10,000-ton cruisers. And, here again, is the question of whether the sacrifices made to secure

the 35-knots or more speed are worth while. By reducing the power over 100 per cent with a speed of twenty-six knots, the German ship has considerable armor and heavier armament. This 10,000-ton battleship will cost more than double and possibly three times what a light cruiser would cost in Germany. Would the United States or British Navy rather have one *Ersatz Preussen* or two *Pensacolas* or *Londons?* That is another way of looking at it. The British and U. S. Navies have battle fleets of heavy capital ships. The Germany Navy does not. That is another factor.

Other navies could profit by following the example of the Germans in using welding more extensively, the use of light alloys and alloy steel where the expense is not too much, and the use of the light-weight Diesel as a cruising auxiliary engine; but, as long as they have their capital ships, some of which approximate the speed and endurance of this new prodigy and have vastly heavier guns, it is not likely that this type of vessel will be found in the building programs of the great navies. They can get more for their money in a cheaper design. Germany is restricted as to the size of the naval vessels she can build; the *Ersatz Preussen* is apparently the most powerful vessel that can be produced on the limited displacement, regardless of expense.

Cruising Radius and Reliability

For high-powered vessels, high-pressure steam and turbo-reduction gears, in which full advantage of use of light alloys and welding is taken, are likely to give a lighter weight of machinery than will Diesel engines. By going the limit on this matter, total machinery weights for a 100,000-horse power installation could be brought down to twenty or twenty-five pounds per horse power, together with a fuel consumption of about 0.6 pound of oil per horse power for all purposes. The corresponding figure for the Diesel would be about 0.45 pound, while the figure for our present light cruisers building would be 0.8 pound. We could be fairly well assured of the reliability of the steam machinery, while the reliability of the very light-weight Diesel would first have to be proved.

The steam plant could secure a very large cruising radius by installing Diesel-electric cruising equipment capable of driving the vessel very economically at about twelve to fifteen knots. This combination would secure a very great steaming radius at low speeds and reliability and reasonable cruising radius at high speeds. It is believed that this, all things considered, would be a better machinery installation for high-speed naval vessels than a full Diesel installation. The Diesel may give a greater radius at the higher speeds, but the light-weight Diesel machinery cannot as yet be regarded as being as reliable.

Use of High-Tensile Alloy Steel for Structure and Machinery

A limited amount of weight can be saved by the employment of higher strength steel; also, by special refinement in design, so that unnecessary metal is left off where it is not needed. In various places lower factors of safety may be employed without serious risk, provided the actual stresses to which the material is to be subjected are known. Perhaps, with all this refinement, a saving of 10 per cent of the metal weight could be secured. This, again, would represent five hundred to six hundred tons, and would mean considerable increase in cost. Special protection from corrosion, also, might enable metal parts to be lighter, since less allowance for corrosion would have to be made.

If the technical designer were unrestricted as to what he might or might not do, he could produce a very material saving in weight, as well as secure substantial reduction in fuel consumption. For various reasons, restrictions are placed upon his decisions and judgments; some of these are often unsound and unjustified. Compromises have to be made to satisfy various requirements. Again, the ship is required to do too many things that interfere one with the other. It is not quite possible to have a greyhound and a bulldog in one unit. It is much more satisfactory to secure two dogs, one of each breed. The upshot of these various compromises and restrictions is that almost any vessel as built does not represent the maximum of what our technical forces can produce.

There is always the danger of trying to have a design do too much. This has accounted for many abject failures in nearly all navies. A ship is limited by her displacement. This cannot be stretched or

twisted into anything else. Usually the most satisfactory designs are those that do not attempt to work magic and allow satisfactory weight and space for everything essential and leave off as many non-essentials as possible.

The *Ersatz Preussen* will be a very interesting engineering experiment and her actual operation will no doubt serve to teach many lessons. There appears to be no compelling reason for the large navies to rush in and build vessels of her particular characteristics. However, many of the technical methods that she employs can be taken advantage of.

NEW LIGHT METALS USED

From some information coming from Germany, it appears probable that both silumen and electron metals are being used largely in connection with the light-weight Diesel engines.

Silumen is an alloy of aluminum, with about 11 per cent silicon and 5 per cent iron. It is a strength metal with better ductility than other aluminum casting alloys and relatively greater strength, and is primarily a casting metal. It does not appear to be any stronger than alloy used in this country and in England. Alloys similar to this are in this country for various special purposes.

Electron metal is a special magnesium alloy, about 90 per cent magnesium, somewhat stronger and lighter than aluminum alloys. It appears to be produced with varying amounts of zinc and aluminum, and sometimes copper. Magnesium alloys have been tried in the United States, but without very satisfactory results, owing to the instability of the material. When tried for pistons of aviation engines it has not shown satisfactory service, and, owing to its tendency to disintegrate, particularly in the presence of moisture and salt water, it is necessary to have some thoroughly effective coating before it can be used with certainty. No doubt some improved means of making this metal more suitable to withstand these conditions have been developed recently, and may be in use on the *Ersatz Preussen,* but until the effectiveness of these measures has been fully demonstrated in service, there is an element of doubt about its lasting qualities. Electron metal would be used largely for castings, but is also supplied rolled and in sheets. It is understood that zinc coatings are sometimes used in protecting it from effect of salt water or other corroding media.

The use of these new alloys shows progressive engineering and enterprise; whether it is rash can only be determined from actual experience.

Pacific and Atlantic Photos

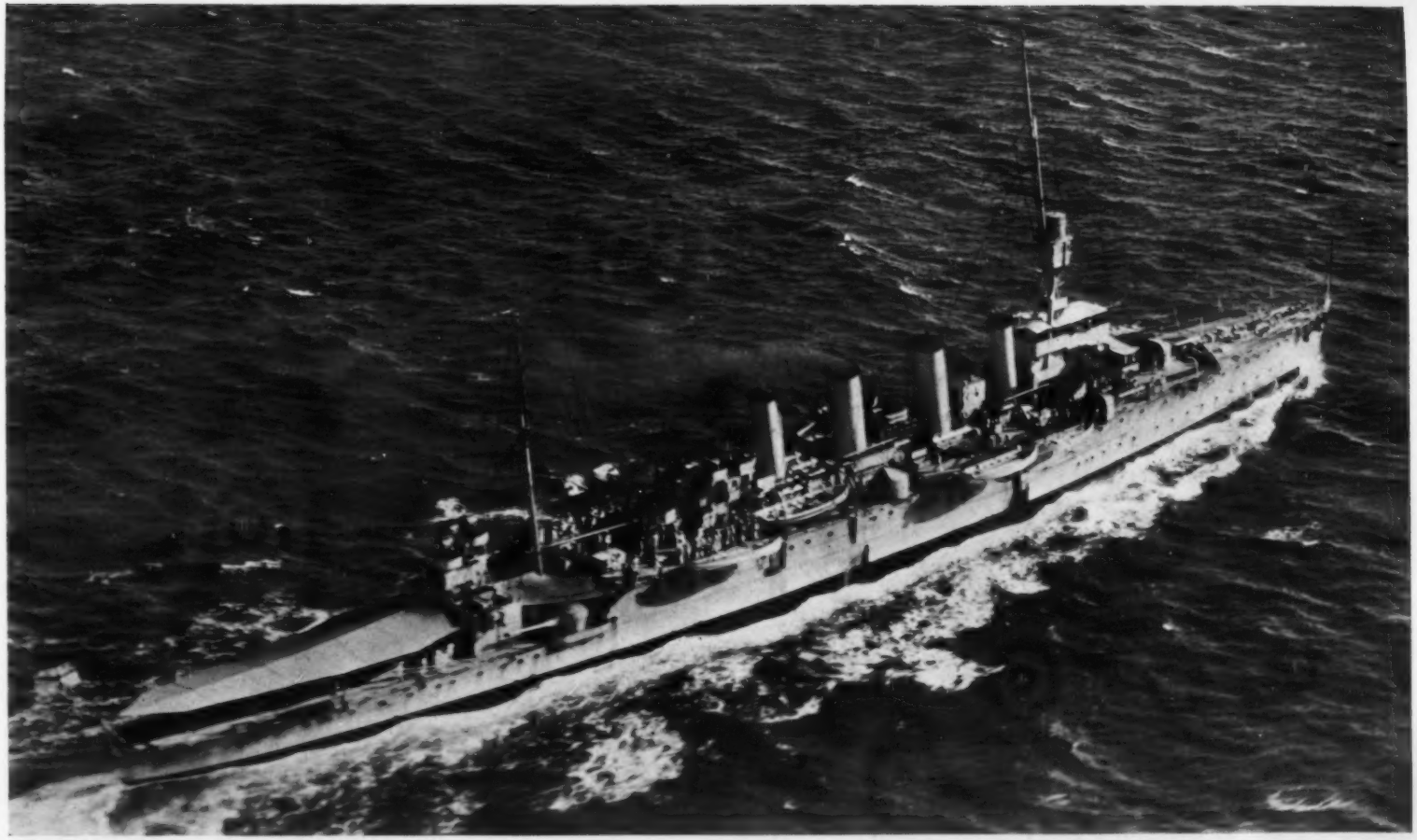
SILHOUETTES

Courtesy J. Jay Pierrepont

THE DESTROYER *TRUXTUN* ON SCOUTING DUTY
Astern of the destroyer is shown the battleship *Texas*.

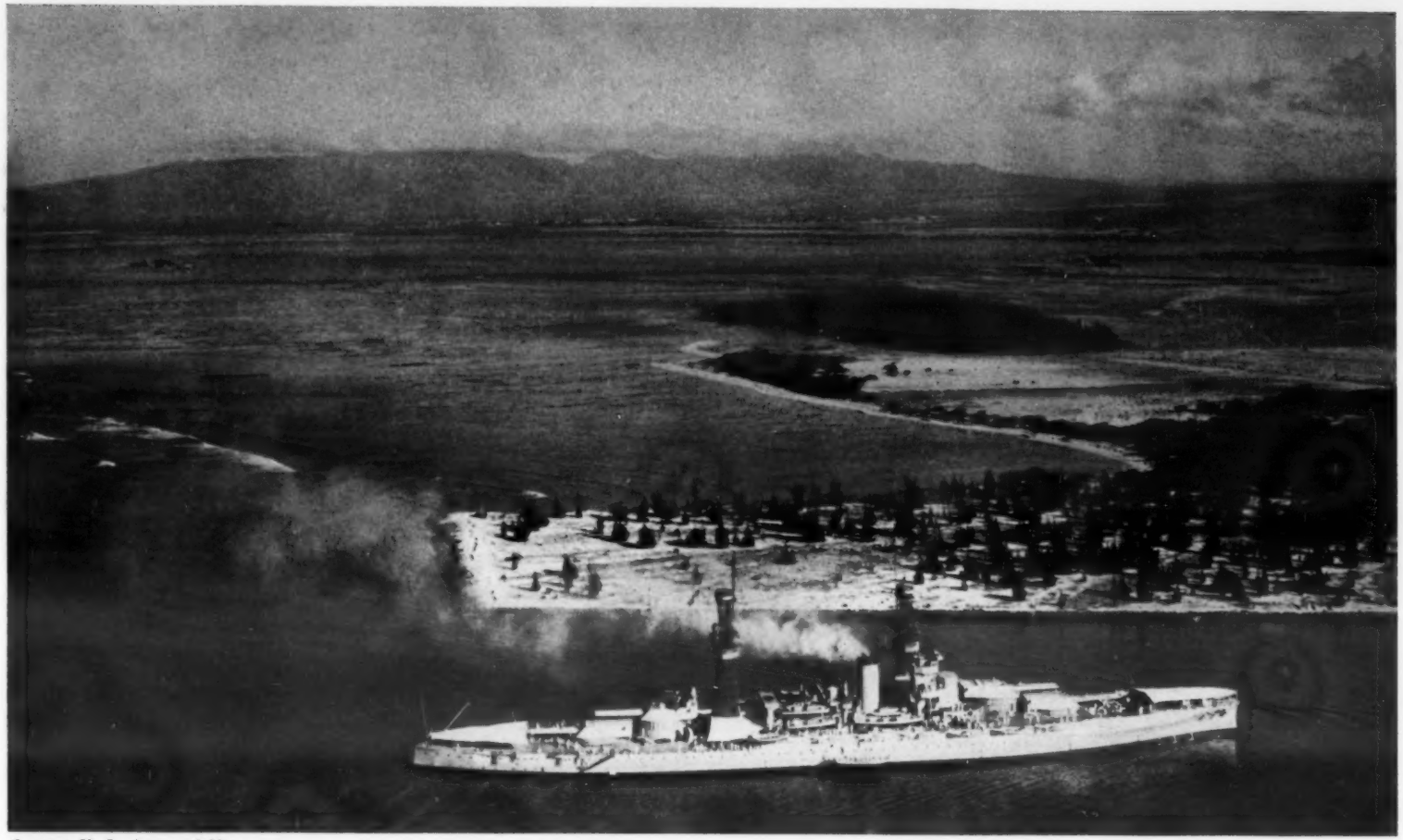
From a painting by Charles R. Patterson

Astern of the destroyer is shown the battleship *Texas*.



Courtesy Bureau of Aeronautics, Navy Department

H. M. S. *BRISBANE*
Outside Honolulu during sesquicentennial held in August, 1928.



Courtesy U. S. Army and Navy

U. S. S. *PENNSYLVANIA* ENTERING HONOLULU, OAHU
August 13, 1928, to take part in the sesquicentennial celebration.

August 19, 1928, to take part in the sesquicentennial celebration.

Courtesy Honolulu "Advertiser"

HOISTING THE U. S. FLAG AT WAIMEA, KAUAI, WHERE CAPTAIN COOK FIRST LANDED ON THE HAWAIIAN ISLANDS

Courtesy Honolulu "Advertiser"

TWO AUSTRALIAN NAVAL OFFICERS PLACING WREATHS AT THE BASE OF THE CAPTAIN COOK MONUMENT, KEALAKEKUA, HAWAII

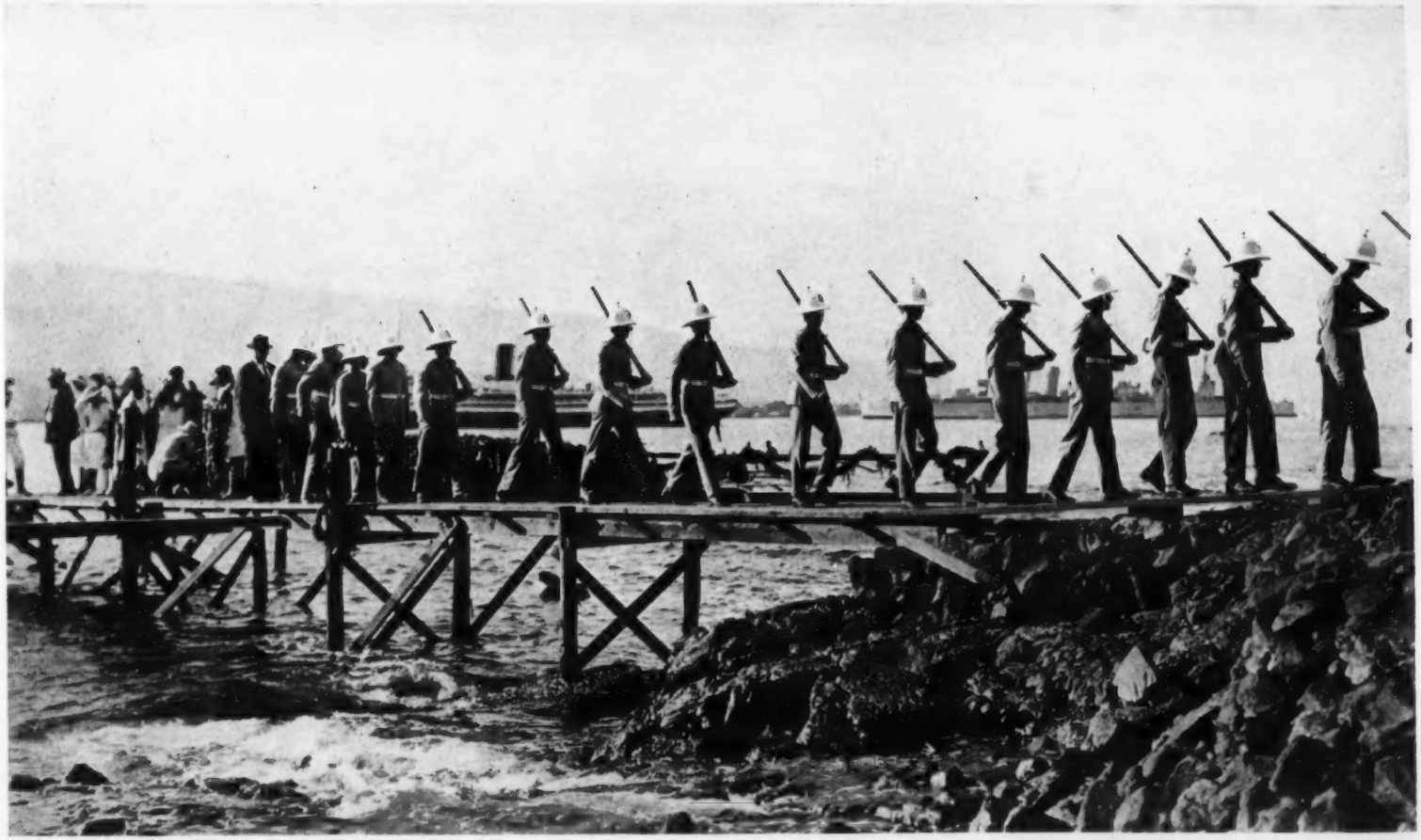
Courtesy Honolulu "Advertiser"

WREATHS BANKED AT BASE OF MONUMENT TO CAPTAIN COOK AT KAAWALOA POINT, KEALAKEKUA BAY, HAWAII

Courtesy Honolulu "Advertiser"

SIR JOSEPH CARRUTHERS (BAREHEADED) LAYING A WREATH OF ROSES ON THE NEWLY DEDICATED MONUMENT TO CAPTAIN COOK AT WAIMEA, KAUAI
Assisting Sir Joseph are the commanding officers of the three British cruisers, *Brisbane, Dunedin,* and *Cornwall,* sent to the Cook sesquicentennial celebration.

Assisting Sir Joseph are the commanding officers of the three British cruisers, *Birmane, Dunedin,* and *Cornwall,* sent to the Cook sesquicentennial celebration.



Courtesy Honolulu "Advertiser"

BRITISH MARINES

Marching ashore at Kaawaloa Point, Kealakekua Bay, Hawaii, to participate in the Captain Cook sesquicentennial celebration.

Courtesy Honolulu "Advertiser"

VIEW OF REPRESENTATIVES OF BRITISH AND AMERICAN DELEGATES AND OTHERS GROUPED ABOUT THE COOK MONUMENT, KEALAKEKUA, HAWAII

Courtesy Honolulu "Advertiser"

OUTRIGGER CANOE APPROACHING THE CAPTAIN COOK MONUMENT,
KEALAKEKUA, HAWAII

Courtesy Honolulu "Advertiser"

SPECTATORS GATHERED AT THE SPOT WHERE CAPTAIN COOK FELL FACE DOWNWARDS AT THE WATER'S EDGE, KEALAKEKUA, HAWAII

Courtesy Honolulu "Advertiser"

HAWAIIAN WARRIORS PADDLING NATIVE CANOES OUT TO GREET THE WARSHIPS

Courtesy Honolulu "Advertiser"

WAR CANOES

Such as were used in the time of King Kamehameha, approaching the Captain Cook monument at Kealakekua, Hawaii, carrying as passengers Governor Wallace R. Farrington, and the then Secretary of War, Dwight F. Davis.

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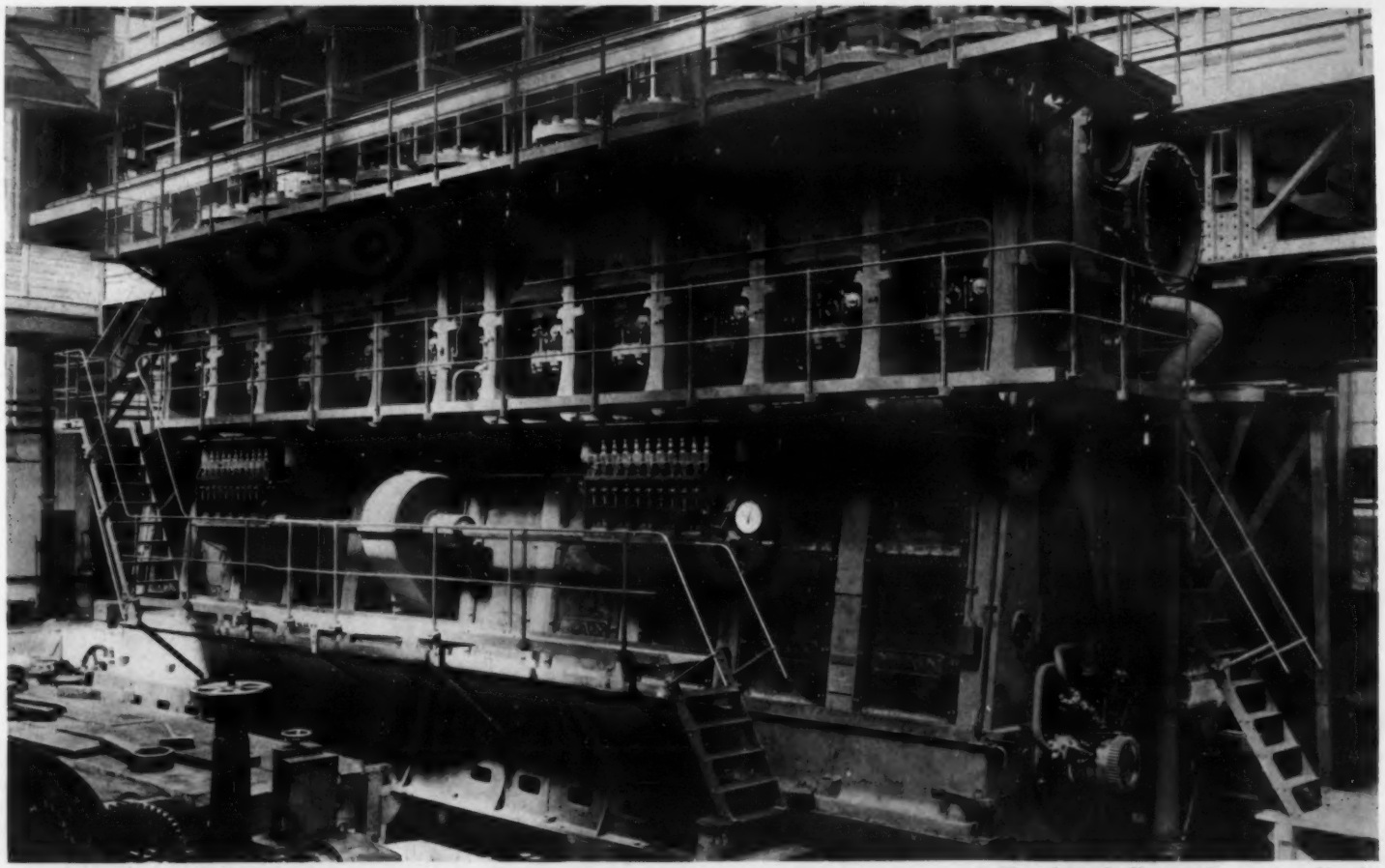
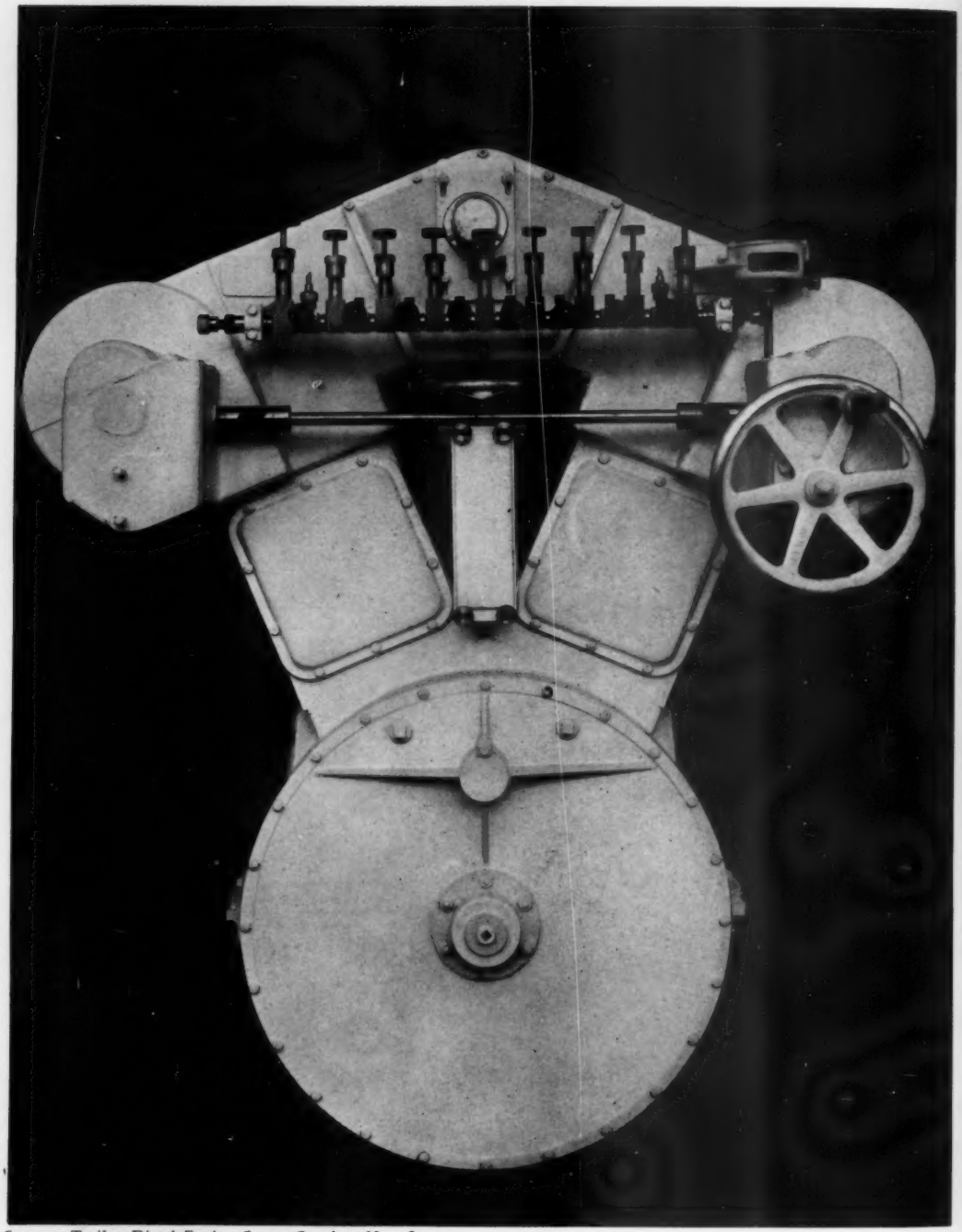


Courtesy M.A.N. Co., Augsburg *Photo from the Hooven, Owens, Rentschler Co.*

FIGURE 1—11,700 B.H.P. TWO-STROKE DOUBLE-ACTING AIRLESS INJECTION M. A. N. DIESEL ENGINE
Built by the M. A. N. Co. Augsburg



Courtesy Treiber Diesel Engine Corp., Camden, New Jersey

FIGURE IV—THE TREIBER ENGINE

The Present Situation *in* Regard *to* Diesel Engines *for* Capital Ships

By CAPTAIN A. M. PROCTER, *U. S. Navy (Retired)*

ON JULY 1, 1928, the world motor tonnage, building, exceeded that of steam tonnage by about thirty-five per cent. That this rate is being continued is indicated by a special London dispatch to the New York *Journal of Commerce,* under date of August 14, which states:

> A feature of the new business is the number of motorships which are to be built on the Clyde, for it is significant that of the orders placed there during the last week or so, all are for motorships, and none are for steamers.

To this may be added the following from the *Engineer* of June 22, 1928, in regard to the new 26,000-ton White Star liner. It is stated:

> There are grounds for believing that she will be propelled by internal combustion engines, but on this point nothing definite has been announced. In this connection, it may be noted that all the vessels now under construction at Queens Island, aggregating over 140,000 tons of shipping, and including a 26,000-ton White Star liner, a 20,000-ton Union Castle liner, and four 15,000-ton Nelson liners, are to be driven by internal combustion engines.

And yet there is not, with the exception of several auxiliaries of purely commercial type, a single Diesel-engined surface war vessel in any navy in the world; and as far as known at present, there is none contemplated.

Four years ago the writer published an article on this same subject, in the July, 1925, number of the PROCEEDINGS of the Naval Institute. This was written for the purpose of indicating to the operating branch of the Navy one outstanding military advantage, that of greatly increased radius of action. The belief was then stated that the Diesel engine had arrived at a point in its development where it could be seriously considered for capital-ship installations.

During the past three years, contact with a large number of seagoing naval officers has indicated a state of mind which, in the language of the modern high-pressure business world, might be called "sales resistance," in regard to the Diesel engine.

Its economy is admitted. It has many obvious advantages. But is it available? Is it reliable? Can sufficient power be developed for large installations, and can the weight be brought down to that of existing steam installations? These questions have repeatedly been raised.

It is our present purpose to examine some of the evidence bearing on these points, and to see what is possible, in the light of present conditions.

RELIABILITY

In the history of the development of the marine Diesel engine the part played by the Eastern Asiatic Company looms very large.

This company, in close coöperation with the firm of Burmeister and Wain, of Copenhagen, began, in 1912, to acquire a fleet of motorships. They made money, and during the troubled times which followed the war they continued to make money, thereby attracting the attention of other ship owners, whose balance sheets forced them to look into this new form of propulsion. During the past year, after an experience of sixteen years with motorships, the announcement was made that as a result of this experience the annual depreciation rate had been reduced from 6 per cent to 5 per cent, which is the usual rate for steamers.

The first motorship built for this company, the *Selandia,* is now approaching the 800,000-mile mark (September, 1928), and from all reports is good for many years to come.

The British shipowner is little given to hysteria, a word recently used by an eminent and distinguished steam engineer in describing the trend towards Diesel engines. His viewpoint is very much broader than that of the average engineer, and, to him, economy means much more than pounds of fuel per shaft horsepower. It means ability to pay dividends, when all the factors of revenue and expense are taken into consideration.

One of the first of these to take up the motorship was Lord Kylsant.

His opinion, expressed in carefully chosen words, was reported in a special dispatch from London to the New York *Times*, under date of December 14, 1926, as follows:

> Lord Kylsant, chairman of the Royal Mail Steam Packet Company, who, by the recent merger of that concern with the White Star, became the world's greatest steamship magnate, speaking today before the Institute of Marine Engineers, of which he is president, said he believed it already a proved fact, that for most trades, and for almost every class of vessel up to the largest ocean-going passenger ship, the motor was not only suitable already, but more economical to work than any other sort of machinery. He capped his remarks by the prophecy that motor engines may some day supersede steam even in the hugest giants.

Quoting Lord Kylsant, this dispatch continues:

> The experience of shipowners who have operated motor vessels is that they are both reliable and dependable. . . . . As a result of my own ten years' experience of motor vessels, I am satisfied that the cost and upkeep and repair is not too high compared with steam engines, and while no definite basis can yet be laid down regarding the rate of depreciation, I do not think that anything exceptional need be anticipated.

Lord Inchcape, writing to the London *Daily News*, has stated:

> The *Aorangi*, 17,500 tons, of the Union Steam Ship Company of New Zealand, has been in the mail service, between Vancouver and New Zealand, since January, 1925, a period of two and one-half years, and has caused her owners not a day's anxiety, running at eighteen knots, or more, economically and with unfailing regularity.

From another source we have information in regard to that ship which touches upon not only the subject of reliability, but also another of equal importance.

ECONOMY IN SERVICE

All of us who have gone to sea in steamers know that it is impossible to maintain trial results in service. The claim has been made that with Diesel engines such is not the case, which is understandable, since the matter of economy is concentrated in well-oiled cylinders, packed with easily renewable piston rings, and not dependent upon innumerable factors which affect the economy of a steam plant.

All available records seem to support this claim, but we have one bit of evidence in regard to the *Aorangi*, whose source gives it a special value.

Oliver T. Allen, of the International General Electric Company, in an address before the Pennsylvania State College meeting of the oil and gas power section of the American Society of Mechanical Engineers, in June, 1928, stated:

> James Smith, superintending engineer of the Union Steamship Company, of New Zealand, when passing through this country on his way to England, a few weeks ago, allowed me to copy some data from his personal log book, and has authorized me to give it to you. It is, therefore, accurate first-hand information from the owners.
>
> The *Aorangi* has made over 300,000 miles in the Pacific service. Up to the end of 1927, when the engines were first overhauled, its performance had been as follows:
>
> | | |
> |---|---|
> | Total miles | 201,043 |
> | Average speed knots | 16.44 |
> | Total fuel, main engines | 23,358 tons |
> | Total fuel, other purposes | 4,891 tons |
> | Engine hours | 12,224 |
> | Average I.H.P. | 14,711 |
> | Average fuel main engines, daily | 45.8 tons |
> | Average fuel, other purposes, daily | 9.0 tons |
> | Fuel per I.H.P. per hour | 0.290 lbs. |
> | Lubricating oil, first voyage | 294 gals. |
> | Lubricating oil, last voyage | 110 gals. |
> | Best day | 18.1 knots |
>
> Now after going about 300,000 miles the fuel per I.H.P., on the voyage of December, 1927, was 0.311 lbs., and for January, 1928, was 0.315 lbs.
>
> Mr. Smith showed me the log of fuel consumption for a large number of voyages, and it is amazing how little variation there is in the amount of fuel per voyage.

The engines of the *Aorangi* have attached air compressors. The scavenging blowers are electrically driven, and the fuel for them is included in that for the ship's auxiliaries. The fuel per I.H.P. above is that for the main engines alone, as is that shown below in the results for the shop tests, which were reported in *Motorship* for August, 1924, as follows:

	¾ load	Full load	Overload	Overload
R.P.M.	114	127	131	152
M.I.P.	74.2	88.1	94.1	89.1
I.H.P.	2967	3915	4321	4750
B.H.P. lbs. sq. in.	2360	3220	3552	3800
Mech. eff. %	79.5	82.2	81.1	80.0
Fuel lbs. B.H.P.	.373	.392	.412	.430
Fuel lbs. I.H.P.	.296	.322	.333	.354

At 14,700 I.H.P. the fuel for main engines alone, under shop-test conditions, would be about 0.317 lbs.

The record of the first trip of the *Aorangi*, out from England, is reported in *Motorship* for March, 1925.

The record for the best day's run is as follows:

Speed (knots)	17.6
Fuel, main engs. tons	44.0
I.H.P.	1,322
Fuel, lbs. I.H.P. per hour	0.311

It is evident from the above that there has been no increase in the fuel per I.H.P. after three years' service.

Weight

There is a persistent belief that the Diesel engine is inherently a heavy machine. A pertinent and timely statement on this subject was made by Dr. Lucke before the Metropolitan Section of the S.A.E.:

> One of the old doubts, heard for many years, was concerned with the weight question. Those who had learned that the old marine Diesel engine of the Burmeister and Wain type, for example, weighed 450 lbs. per hp., jumped to the conclusion that no Diesel engine could be made light enough for automotive service. For a long time no analysis was made of the prime factors, and the shock of learning that the large M.A.N. submarine engine weighed 50 lbs. per hp., was survived by the still vague conclusion that this must surely be the low limit.
>
> This was all nonsense, of course, and more people are learning the elements of weight well enough to accept the statement that an automotive engine can be made to weigh not more than thirty per cent more than an automotive gasoline engine, although not many are ready to believe that there is no inherent reason why it may not be made actually lighter than the gasoline engine.

Now the automotive gasoline engine, as installed in the airplane, is the lightest known form of power, having reached a figure of about one pound per B.H.P.

The aëro engine with a cylinder diameter of about five inches runs at about 2,700 feet per minute piston speed.

If the cylinder diameter is increased up to that necessary for marine installations, a materially lower piston speed will be possible, due to the larger inertia forces with a heavier oil-cooled piston.

Making the extreme assumption that the increased reciprocating weight would necessitate a reduction of piston speed to 2,000 feet per minute and remembering that the weight per B.H.P. in similar engines varies as the ratio of the linear dimensions, it follows that for a 20-inch cylinder, the weight per B.H.P. should be less than six pounds.

All of which goes to show that even in the lightest known Diesel engine, we are very far from having reached the low limit.

Costs

The cost of the Diesel engine is at present greater than that of the steam plant of equal power.

There are two factors which have been largely responsible for this.

First, the power delivered per unit weight has been too low.

The obvious cure for this is to get more power per unit weight, and there are signs that this is coming.

The cheapest form of power, on the basis of first cost, is found in the aëro engine where, notwithstanding the high unit cost of about $10 per pound, the cost per B.H.P. is about $20.

The second factor which has operated to keep the cost of marine Diesels above that of the steam engine is that of development costs, which have not been absorbed owing to few orders and changing designs.

There is no inherent reason why a Diesel engine should cost more than a steam engine.

A very good cast-iron engine can be bought for about thirty cents a pound. Allowing for a very liberal increase in the unit cost of fifty cents a pound, an engine weighing sixty pounds per B.H.P., which is the weight of the latest Augsburg double-acting engine, would give a cost of $30 per B.H.P.

This is something less than one half the cost of a slow-speed, heavy-duty engine in this country.

Most Diesel engineers know these things, but few of them can afford to speak as

frankly as Dr. Lucke has spoken on the weight question.

It may be interesting to know that the latest Augsburg double-acting engine was designed because the cost of the large Hamburg engine was considered too high, and that the total investment in the Hamburg station was less in cost per B.H.P. per hour than the cost of a Diesel engine in this country.

WHAT POWER PER CYLINDER IS POSSIBLE?

The largest cylinder in existence today is the two-cycle double-acting Sulzer experimental cylinder which has a diameter of 35.5 inches, and is capable of developing about 3,500 B.H.P., with independently driven auxiliaries. This cylinder cannot be used in a naval vessel on account of its great height. This engine was probably under construction at the time the words "possible but improbable miracle" were used in commenting on the writer's suggestion that a 34-inch cylinder, developing 2,600 B.H.P. at overload rating, was practicable. By decreasing the ratio of stroke to bore to a minimum, a 34-inch cylinder could be installed in the present type battleship. Considering the factors of weight, space, and revolutions, a smaller cylinder would give a better result, and our present opinion is that a compromise on a cylinder 28 inches in diameter, and a stroke of 42 inches would provide the most economical combination. The power per cylinder at a moderate rating would be about 2,000 B.H.P. We believe now as we did three years ago, that a Diesel engine for naval use should be designed for the purpose.

We did not in the days of the reciprocating steam engine put the commercial types of boilers and engines in battleships, and the conditions today with respect to the Diesel engine produce an exactly similar situation.

The probability of this course, however, is remote, and it is proposed to examine the field and to see if there are any existing engines which can be used for the purpose with direct drive, electric drive, or geared drive. We find two such engines; there are probably others, but an examination of the possibilities of these two will serve our present purpose.

THE AUGSBURG TWO-CYCLE, DOUBLE-ACTING, SOLID INJECTION, HIGH-SPEED ENGINE

The engineering world has learned to value announcements coming from the Augsburg branch of the M.A.N.

It is therefore pertinent to quote from an article by P. von Schuh in which the first definite information was given to the world in regard to their latest engine. This was published in *Engineering Progress*, a journal printed in English by the V.D.I., in December, 1927.

> The efforts of the designers have therefore been concentrated upon applying the two-stroke double-acting principle to engines working at higher speeds and thus to enlarge its field of application.
>
> The work in this direction was aided by the demand for high-speed engines, for small and medium output for special purposes like locomotives, for which the double-acting two-stroke engine is predestined, as it were, owing to the almost ideal way in which the cylinders and driving gear are utilized. The work in this field of high speeds has not been completed. They necessitate particular care in the selection of materials and in the design, considering that piston speeds are involved which are in the neighborhood of 9 m. per sec. (1771 ft. per min.).
>
> Much experience will therefore still have to be gathered, but, as far as can be judged at present, the hope is justified that a successful issue will be reached. Between the two limits, however, there are conditions which can, and must be made use of to the full.
>
> Piston speeds up to 7 m. per sec. (1378 ft. per min.) have been used in practice for some time, and the scavenging of two-stroke engines, at such speeds, is thoroughly satisfactory and insures perfect combustion.
>
> There is no longer any risk, nowadays, in building two-stroke, double-acting engines with, say, 215 R.P.M. and a stroke of 900 m.m. (35.6 in.), which corresponds to a mean piston speed of 6.45 m. per sec. (1276 ft. per min). At this speed a cylinder of 600 m.m. (23.5 in.) bore gives an output of about 1170 effective H.P. at a mean pressure of about 5.1 kg. per sq. c.m. (73 lbs. per sq. in.), hence a 10 cylinder 11700 effective H.P. . . . . Two engines of the type and size described, with solid injection of the fuel, have recently been ordered of the M.A.N.'s Augsburg works by the Märkisches Electrizitätswerk A.G. of Berlin.

These engines, for carrying peak loads in the Hennigsdorf transformer station have now been completed and the trials run. (*Motorship*, August, 1928.)

A photograph of this engine is shown in the illustration preceding this article. It will be noted that this engine, which is similar to the most recent marine type, is much

FIGURE 2

Sketch of Transverse Section Battleship Machinery Space, With High-Speed Two-Cycle, D. A. Augsburg Engines. Cyl. Diam. 23.5 in. Stroke 35.6 in. R. P. M. 215. B. H. P. Total—36160. Wt. Total Propelling Machinery 1504 Tons. Wt. B. H. P. Propelling Machinery—60 Lbs.

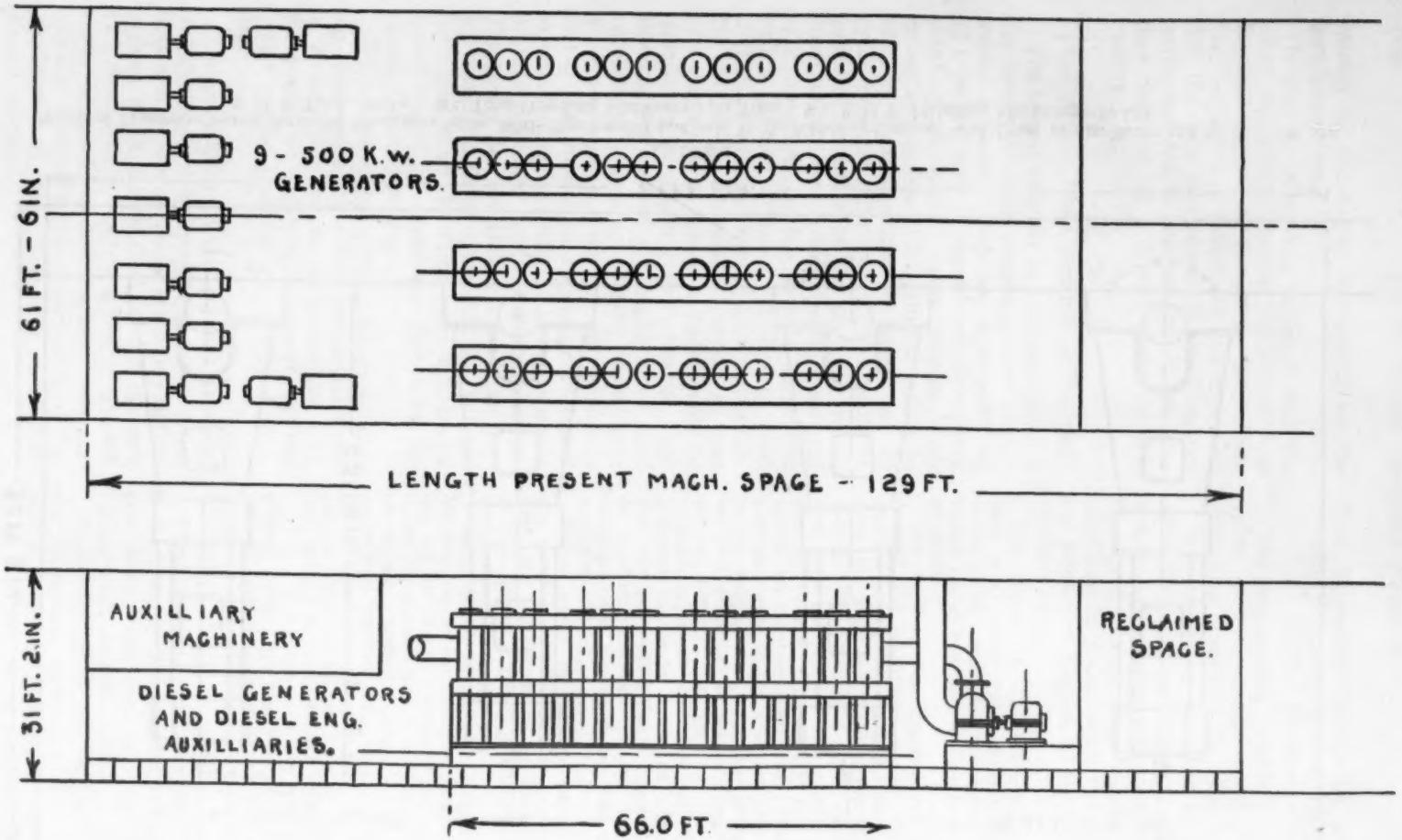


FIGURE 3

Sketch of Battleship Machinery Space With High-Speed Two-Cycle, D. A. Augsburg Engine. Cyl. Diam. 23.5 in. Stroke 35.6 in. R. P. M. 215
B. H. P. Total—56160 Wt. Propelling Machinery 1504 Tons. Wt.—B. H. P.—60 Lbs.

more compactly designed than the previous type, that of the Magdeburg and Augustus.

No drawings of this engine have as yet been published, but it is possible to reduce the drawings of the Magdeburg engine, which has been published, to the same stroke and bore, with a negligible percentage of error, and be sure that the resultant engine will be somewhat larger than the high-speed type.

In view of von Schuh's remarks on piston speed, and in view of the moderate mean pressure used, it is certain that for full-power naval conditions, a materially higher power could be developed.

Since, however, these engines are built to carry peak loads, where the conditions are somewhat similar to full-power naval conditions, the builder's rating of 1170 B.H.P. per cylinder can be taken safely.

A four-shaft arrangement of this engine with twelve cylinders on each shaft is shown in Figs. 2 and 3.

The large generator capacity shown is necessary to provide power for the electrically driven scavenging blowers.

The general characteristics of this installation are as follows:

No. of cylinders	48
No. of shafts	4
Cylinder diameter	23.5 in.
Stroke	35.6 in.
R.P.M	215
Piston speed	1,278 ft. per min.
B.H.P. per cyl.	1,170
B.H.P. total	56,160
Wt. per B.H.P.	60 lbs.
Wt. propelling machinery	1,504 tons
Total engineering weights	2,149 tons

The weight of the Augsburg engine is stated to be 55 lbs. per B.H.P., but this refers undoubtedly, to the weight of the engine alone. A fair allowance for the scavenging blowers, motors, and generators would be ten per cent of the engine weight which brings the total weight up to 60 lbs. per B.H.P. The total engineering weight is based on the assumption, according to an analysis in the previous article, that the propelling machinery weights are seventy per cent of the total engineering weights.

The installation shown in Figs. 2 and 3 is in the machinery space of a 30,000-S.H.P. electric-drive ship.

The engines for generator drive are V-type Treiber engines, having a cylinder diameter of 9.5 inches and a stroke of 12.0 inches. These engines are normally rated at 720 B.H.P.

For scavenging, the power required at the blower shaft will be about 2200 H.P. With eighty per cent electric efficiency the engine B.H.P. will be 2750. At full power, this will require six engines, leaving about 1,500 K.W. for other auxiliaries.

The S.H.P. of the *West Virginia* is about 30,000. The weight of the machinery is materially greater than 2,000 tons. On the same total weight it should be possible to install about eighty-five per cent more power than that developed with the present turbo-electric drive.

The Treiber Engine

It is obvious that the Treiber engine, which was described in a paper read by the designer before the Society of Naval Architects and Marine Engineers, on November 11, 1927, cannot be used for direct drive. This engine represents a daring and, in our opinion, successful attempt at weight reduction, through a combination of high rotative speed, and low specific weight, obtained by careful design and the extensive use of aluminum alloys.

In a capital-ship installation, where extreme weight reduction is not necessary, the use of aluminum alloys for the engine framing is not desirable. There is however, no risk in substituting steel and iron castings, as has been done in two smaller but similar engines. One of these smaller engines is shown in Fig. 4, immediately preceding this article.

The weights per cubic inch cylinder volume of these two engines are as follows:

Large engine, 16 in. cyl. diam.	1.63 lbs.
Small engine, 9.5 in. cyl. diam.	1.76 lbs.

The large Treiber engine has been weighed. Its weight is 63,000 lbs. without the auxiliaries, which for a solid-injection engine will not be over 4,000 lbs.

Using the weight per cubic inch of cylinder volume of the small engine, the large engine will weigh about 73,000 lbs. including the necessary auxiliaries.

The rating of an engine must be based on the service for which it is intended, and the full-power rating of this engine, 3,000 B.H.P., would be higher than desirable for a capital-ship installation.

This engine being near the same power of the 3,000 B.H.P. Augsburg submarine engine, a comparison with that engine will assist in deciding on a permissible rating.

The fixed characteristics of the two engines are as follows:

	Augsburg	*Treiber*
Cyl. diam. ..	20.875 in.	16.0 in.
Stroke	20.875 in.	16.0 in.
Weight	207,000 lbs.	73,000 lbs.
No. of cyls...	10	12
Total cyl. vol.	71,370 cu. in.	38,592 cu. in.
Weight per cu. in. cyl. vol..	3.0 lbs.	1.9 lbs.

In the Treiber engine, an oil-cooled aluminum-alloy piston, with a light section connecting rod, brings the weight of the reciprocating parts, on a cu.-in.-cyl.-vol. basis, down to about sixty per cent of that for the Augsburg engine.

The Treiber engine has four valves, with a ratio of valve area to piston area about ninety per cent greater than that of the Augsburg engine, which has but two valves. In the full-power trials of the original German-built Augsburg engine, 3,005 B.H.P. was developed at 389 R.P.M., with an average mean indicated pressure of 122 lbs. per sq. in.

Since the Treiber engine is a solid-injection engine, and since the injection air is available to support combustion, this engine will, with the same cylinder conditions, develop about eighty-seven per cent of the mean indicated pressure of the Augsburg engine, which is an air-injection engine. But the cylinder conditions in the Treiber engine due to the larger valve-area ratio, are materially more favorable, at high speeds, than in the Augsburg engine, and it is more than fair to allow the Treiber engine eighty-seven per cent of the maximum pressure of the Augsburg engine, which was about 135 lbs. per sq. in. This would permit a mean indicated pressure of 117 lbs. per sq. in. for the Treiber engine.

The question of deciding which of the various factors is the limiting one is a difficult matter. We have made a complete analysis of the performance of both engines, and arrived at the conclusion that the limiting factor for the Treiber engine is the load on the center main bearing. This bearing, in both engines, carries the heaviest load of all the bearings, and in the Augsburg engine has a value of 20,000 ft. lbs. per sq. in. of projected bearing area.

It is by no means certain that this is the upper limit but if it can be exceeded in the Augsburg engine it can be exceeded in the Treiber engine, and the Treiber engine has the advantage in all other respects.

Compared on this basis, the same load on the center main bearing, the characteristics of the two engines are as follows:

	Augsburg	*Treiber*
R.P.M.	389	550
Piston speed ft. min.....	1,356	1,475
M.I.P. lbs. per sq. in.....	122	117
I.H.P. per cyl.....	429	263
Mech. efficiency %.....	70	85
B.H.P. per cyl.....	300	223
B.H.P. total.....	3,000	2,676
Wt. per. B.H.P. lbs.....	69	27
Maximum inertia force (1 crank) lbs.....	95,823	73,734
Max. inertia force lbs. sq. in. piston.....	280	244
Max. inertia force lbs. sq. in. bearing.....	720	716
Bearing load, center main bearing, ft. lbs. per sec. per sq. in. bearing area	20,000	20,000

The rating above of the Augsburg engine is the original German rating.

The question as to a proper rating for full-power naval conditions is a matter of opinion. Having witnessed the original trials of that engine, and having had the advantage of association with the personnel connected with those trials, as well as the subsequent trials of the *T-3*, we have formed an opinion which may be stated as follows: If the attached pumps, which have no more right to a place on a Diesel engine than they had on a reciprocating steam engine, are removed, a conservative rating for the stated conditions would be 2,600 B.H.P.

On this basis, the corresponding rating for the Treiber engine would be about 2,400 B.H.P.

With the wide speed range required in naval engines the geared drive introduces problems due to torsional vibration which have not been solved.

It is probable that these problems can, and will, be solved, but until this is done this form of drive must be considered as an experimental and doubtful proposition. This leaves the electric drive as the only available form of transmission. Difficulties of parallel operation and speed control with

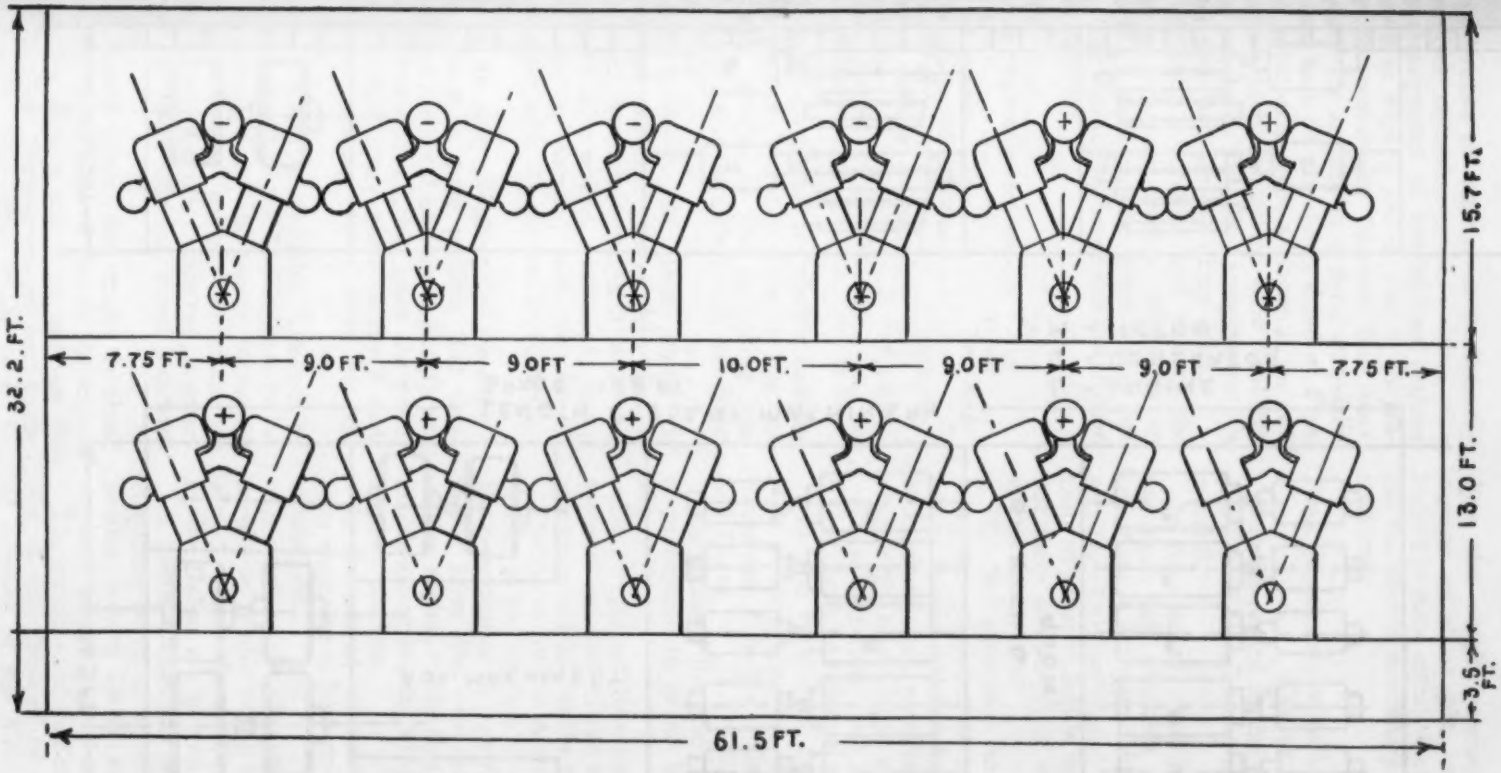


FIGURE 5

Sketch of Transverse Section of Battleship Machinery Space with Treiber Engines. Electric Drive. Cyl. Diam. 16.0 in. Stroke 16.0 in. R. P. M. 550 B. H. P. 57,000. S. H. P. 51,840.

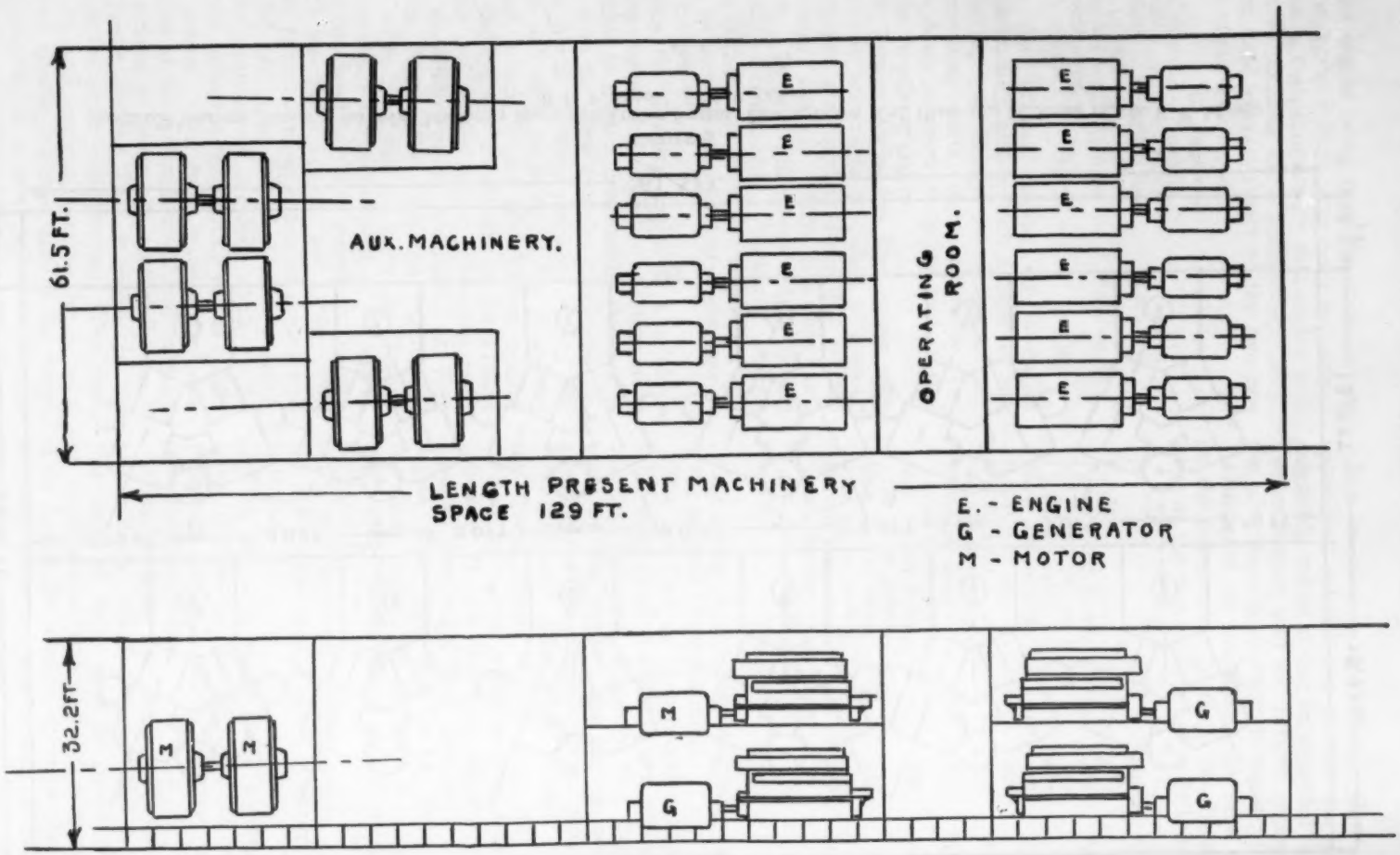


FIGURE 6

Sketch of Battleship Machinery Space With Treiber Engines. Electric Drive. Cyl. Diam. 16.0 in. Stroke 16.0 in. R. P. M.—550 B. H. P. 57,600 S. H. P. 51,840

a large number of units make it necessary to use direct current.

An arrangement of twenty-four engines is shown in Figs. 5 and 6. Due to the absence of scavenging blowers, the space necessary for auxiliaries will be materially less than that for the direct drive of Figs. 2 and 3, but even then, a glance at the two arrangements is enough to show that the space required for this arrangement is greater than that for the direct drive.

With D.C. generators and motors the maximum over-all electric efficiency, in 2,400 H.P. units, will be about ninety per cent. The characteristics of this installation are as follows:

B.H.P. total	57,600
Electric efficiency percentage	90
Shaft H.P.	51,840
Wt. of engines	771 tons
Wt. available for propelling machinery	1,504 tons
Balance available for electric installation	733 tons
Weight per S.H.P. electric installation	32 lbs.

The weight available for electric installation is too low, and it is quite certain that the total weight of the propelling machinery will be greater than with the direct drive.

Since, however, the total power is seventy-two per cent greater than that of the present steam installation it is certain that, on the same weight, a materially larger power can be installed with the Diesel-electric than with the present turbo-electric drive.

There are many advantages of the electric drive, and it is quite possible that these advantages are great enough to justify this form of transmission, but from the standpoint of weight, space, and economy, it must be evident that the direct drive has the advantage.

There is a method available, however, by which the weight of the Treiber installation can be reduced or its power increased. Without resorting to any uncertain or untried expedients, this engine can be supercharged to about 160 lbs. mean indicated pressure.

This would reduce the weight to about seventy-three per cent of that of the engine weights for Figs. 5 and 6, or increase the power by about thirty-seven per cent on the same weight. The effect would be to reduce the weight required for the main engines to about 563 tons, which would leave 941 tons, equal to 41 lbs. per S.H.P., for the electric machinery, which should be sufficient.

Fuel Consumption of Steam and Diesel Engines

Data in regard to the economy of steam and Diesel installations is shown in Figs. 7 and 8.

In the case of steam installations, there are much data available as to trial results, but there is little available as to results in service. Data in regard to service conditions of naval vessels is held as confidential, but there is one bit of evidence available which can be used.

The fuel allowance curve for the *Oklahoma* was published in an article by Lieutenant Weber and Lieutenant Styer, in the November, 1925, number of the Proceedings of the Naval Institute.

These data have been put on a fuel-per-S.H.P. basis and plotted on Fig. 7.

No trial results for the *Oklahoma* have been published, and it has been necessary to use data from the trials of the *New York* and *Texas*.

The mean of the trial results of these two ships reduced to an oil basis is plotted on Fig. 7.

By comparing these two curves a fairly accurate estimate of the increase of service results over trial results is possible.

The curve for the Augsburg D.A. engine, in Fig. 7, for varying revolution conditions, has been plotted by applying the factor obtained from the two curves of the submarine engine, to the shop-test curve of the double-acting engine, which was run at constant revolutions.

In the case of the submarine engine, the tests were run at both constant and varying revolutions.

A check on the character of the varying-revolution double-acting curve is shown on Fig. 7, where the results of the sea trials of the *Dolius* are plotted.

A liberal factor has been applied to the Augsburg curve, to establish a curve representing service conditions for the Diesel engine. This is plotted on Fig. 8.

The service-condition curve for steam, on Fig. 8, was obtained by adding the factor of increase of the *New York* and *Texas*

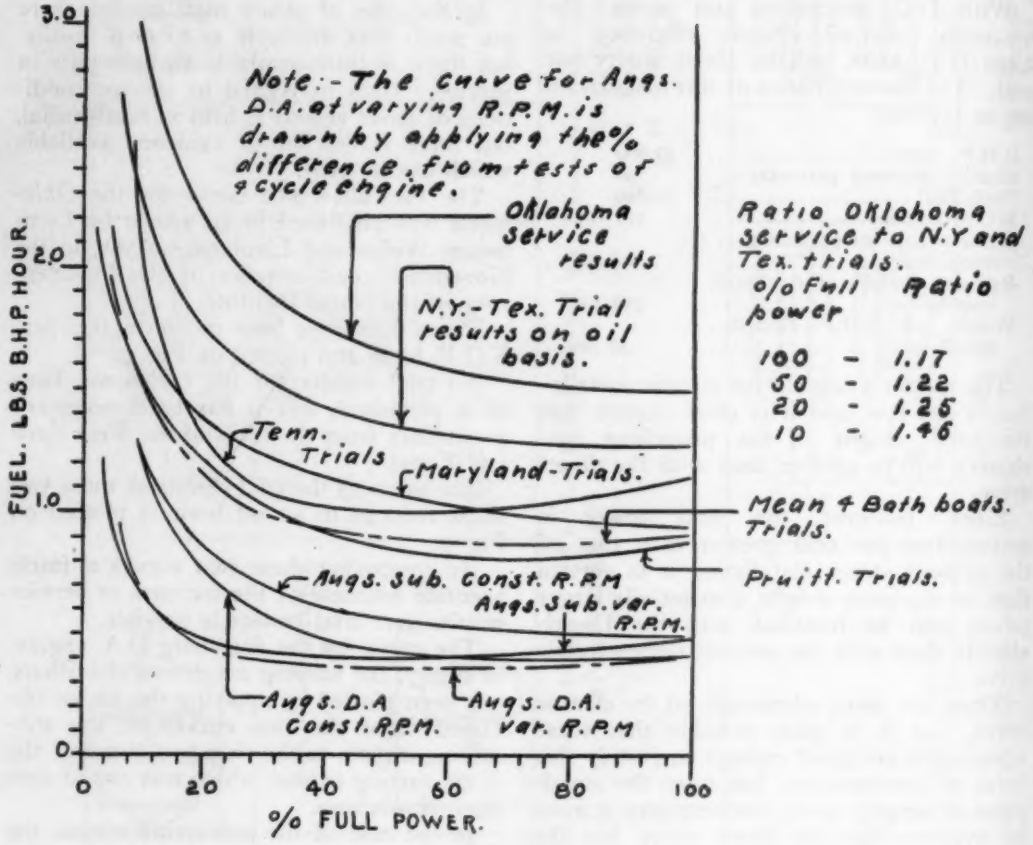

3.0
2.0
1.0
0
FUEL. LBS. B.H.P. HOUR.
0
20
40
60
80
100
% FULL POWER.
Note:- The curve for Augs. D.A. at varying R.P.M. is drawn by applying the % difference, from tests of 4 cycle engine.
Oklahoma service results
N.Y.-Tex. Trial results on oil basis.
Tenn. Trials
Maryland-Trials.
Mean 4 Bath boats. Trials.
Pruitt. Trials.
Augs. Sub. const. R.P.M
Augs. Sub. var. R.P.M.
Augs. D.A Const. R.P.M.
Augs. D.A. var. R.P.M
Ratio Oklahoma service to N.Y and Tex. trials.
% Full power
Ratio
100 - 1.17
50 - 1.22
20 - 1.25
10 - 1.46

FIGURE 7

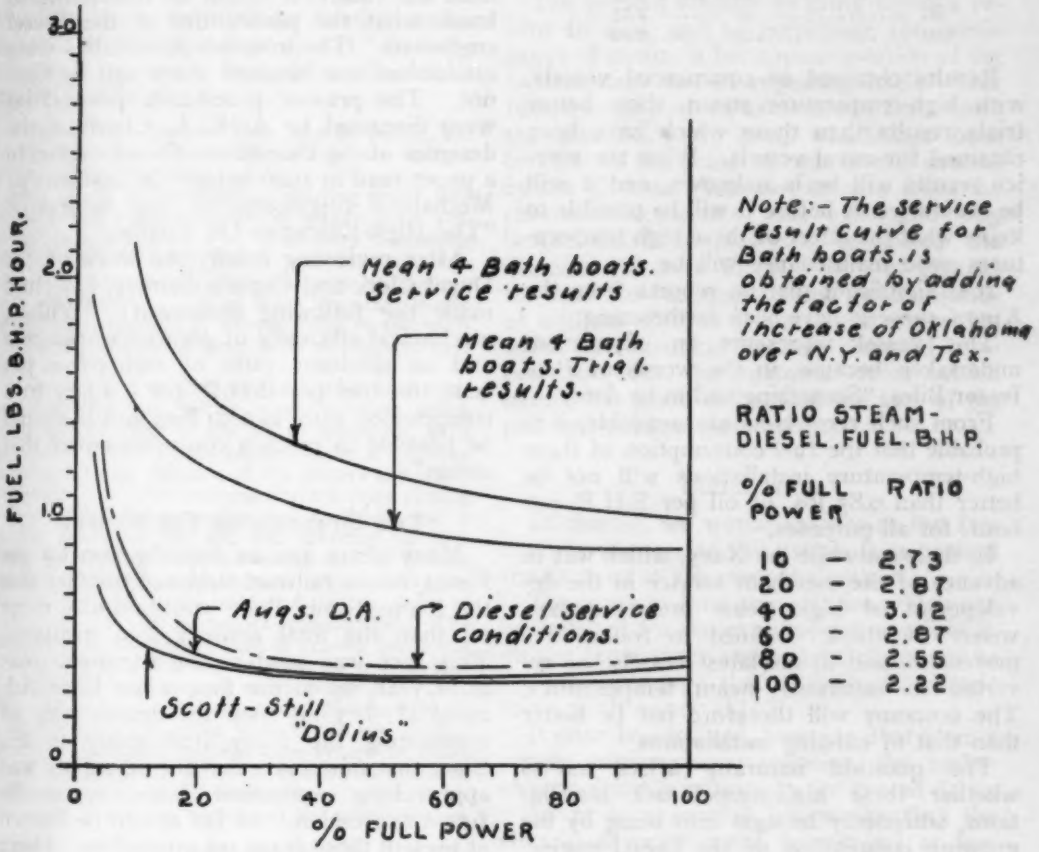

FUEL. LBS. B.H.P. HOUR.
3.0
2.0
1.0
0
Mean 4 Bath boats. Service results
Mean 4 Bath boats. Trial results.
Augs. D.A.
Diesel service conditions.
Scott-Still "Dolius"
0
20
40
60
80
100
% FULL POWER
Note:- The service result curve for Bath boats is obtained by adding the factor of increase of Oklahoma over N.Y. and Tex.
RATIO STEAM-DIESEL. FUEL. B.H.P.
% FULL POWER RATIO
10 - 2.73
20 - 2.87
40 - 3.12
60 - 2.87
80 - 2.55
100 - 2.22

FIGURE 8

over the *Oklahoma*, to the trial results of four Bath destroyers.

The results of a comparison of these curves is as follows:

Per cent full power	*Ratio steam consumption to Diesel consumption*
10	2.73
20	2.87
40	3.12
60	2.87
80	2.55
100	2.22

Results obtained in commercial vessels, with high-temperature steam, show better trials results than those which have been obtained for naval vessels. What the service results will be is unknown, and it will be several years before it will be possible to know what the effect of these high temperatures upon maintenance will be.

It is significant that no reports from the *King George V* have been forthcoming.

This vessel represents an experiment undertaken because, in the words of Professor Biles, "Something had to be done."

From such records as are available, it is probable that the fuel consumption of these high-temperature installations will not be better than 0.85 lbs. of oil per S.H.P. per hour, for all purposes.

In the meanwhile the Navy, which was in advance of the merchant service in the development of high steam pressures, has, wisely we think, declined to follow this movement, and in the latest vessels has reverted to saturated steam temperatures. The economy will therefore not be better than that of existing installations.

The question naturally arises as to whether these high-temperature installations, admittedly brought into being by the growing competition of the Diesel engine, are not more uncertain and experimental than the Diesel engine. Time alone will tell. In the meanwhile the great shipowners, who alone have the necessary information as to the cost factors of steam as well as Diesel installations, continue to order motorships.

Future Possibilities of the Diesel Engine

During the past ten years, while intensive efforts have been made to improve the mechanical features of Diesel engines, comparatively little effort has been made to improve its economy.

Competition of the Diesel has forced the steam engineers to attempt to improve the steam plant.

There are now signs that this attempt is resulting in more attention to the economy of the Diesel engine.

While not pertinent to this discussion, which has to do with the present, rather than the future, it might be interesting to know what the possibilities of the Diesel engine are. The inherent possibilities were established one hundred years ago by Carnot. The present practicable possibilities were discussed by A. E. L. Chorlton, the designer of the Beardmore Diesel engine, in a paper read in 1926 before the Institute of Mechanical Engineers, on the subject of "The High-Efficiency Oil Engine."

After reviewing briefly the work of Sir Dugal Clerk and Captain Sankey, Chorlton made the following statement: "With a mechanical efficiency of eighty-five per cent and an efficiency ratio of eighty-five per cent, the fuel per B.H.P. for a 13.25 to 1 compression ratio is 0.30 lbs., and it should be possible to reach a consumption of that order."

The Question of Oil Supply

Many years ago an investigation by the Pennsylvania railroad disclosed the fact that the Pennsylvania alone would require more oil than the total amount then available. This fact was used as an argument year after year, up to the time when Rear Admiral H. I. Cone took the drastic step of committing the Navy irrevocably to oil. Since that time fears that the oil supply was approaching extinction have repeatedly found expression. As far as can be known at present these fears are groundless. There is in sight an ample supply for the immediate future, and when that supply of natural oil is in danger of exhaustion, we are ready to take advantage of a movement which has taken place in the past twenty-five years of which the general public has been but vaguely aware.

The chemist has come into his own. Working during the past century as a pure scientist he learned to take things apart.

He has now learned to put them together again in a way to suit the needs of humanity, and in the meanwhile he has become

an engineer. As far as transportation is concerned this is a liquid-fuel world and such it will remain.

When the American workman uses coal dust in his automobile, the Navy will stop using oil, but we do not expect to see either of these things happen.

There are from time to time outbursts of indignation from gentlemen who believe in the goodness of things as they were.

Under the name of "Poseidon," one of these, writing in the *National Review*, under the title of "In Bondage to Oil," has the following to say in regard to England's present critical situation:

> What are the facts? They may be baldly, but truthfully stated thus: The Navy has become exclusively oil burning. . . . .
>
> The Army is feverishly converting itself into an oil-driven conglomeration of dangerously vulnerable machines. . . . . It is very commonly believed that oil-fired boilers and internal combustion engines are a *sine qua non* of modern naval efficiency. . . . . This is not the case. Welsh steam coal is capable of driving ships as efficiently as oil, and, indeed has some great advantages over oil. . . . .
>
> It is true that coaling ship is a great and ever-recurring exertion, but it is an exertion which brings untold good to the Navy, providing, as it does, an evolution of the highest value in building up the spirit and physique of the officers and ships' company. . . . . The training derived from coaling a ship, both in seamanship and hardship, was a worthy successor to the old training in sail. When we used to coal, we had a race of British stokers, engineers, and seamen who were to a modern fleet what old-fashioned sailors were to a fleet which our ancestors commanded. The handling and stoking of coal is rapidly becoming a lost art for which the opening of a few taps and valves is a poor and sorry substitute. . . . . If the great merchant mariners of England could be induced to coöperate with the Navy in this great and necessary reform (the return to coal) they would assuredly have the reward in a return to general prosperity. Furthermore where England leads at sea the nations of the world follow.

When we read this, out of the dim recesses of memory came the consciousness that we had heard something strangely like this before. On page 320, volume 22, of the PROCEEDINGS of the Naval Institute, we find the following, written in 1896:

> It is my sincere belief that square-yard-and-sail training is the cornerstone and capstone of the seaman and officer as much today as in the time of John Paul Jones. . . . .
>
> Away with your sails, if you please; strip your masts of their yards, but after you have done so, produce me a man to compare in fertility of resource, in keen judgment, in fearlessness, in dash, in courage, in leadership, in all that makes a manly man, with one who has been trained at the weather earring, or in smothering the mad billows of a thrashing sail! You can't do it. There is something about the sailing-ship sailor which marks him from his mates of the shovel and oil can on board ship. . . . .*

Thus does the world move on. The radical of one generation becomes the conservative of the next; fighting for the maintenance of the condition which he had helped to bring about.

The present attempt to bring about a return to coal, and to perpetuate the dominance of steam, is but a manifestation of the habit history has of repeating itself. Our future supply of oil is assured; first, from the distillation of coal, which has been brought to the point of commercial success by the German chemists; second, from the enormous deposits of oil shale; and long before these sources are exhausted the chemist will have found a way to give us the fuel for our needs from the thousands of millions of tons of equatorial vegetation which are identical in their chemical composition with the material from which nature has made and stored the fuel of the past and present generation.

CONCLUSION

In closing, we would emphasize the fact that the purpose of this article is to present the facts as to the present situation.

There are at least two engines which can be installed for powers above 50,000 S.H.P. on the same space and weight allowance as the preferred type, that of the turbo-electric drive, with 30,000 S.H.P.

It must be admitted, however, that from a purely engineering standpoint, the turbo-electric drive is inferior to the geared drive.

There is a general impression that the electric drive is more economical at low powers, but a glance at Fig. 7 will show that such is not the case.

In the latest destroyers, and in the scout cruisers, the comparison is much more favorable to the steam installation. There is no Diesel engine today which can be installed on the same weight as that of the geared-turbine drive. There is not a shadow of doubt that such an engine can be built, but that is another story.

In the merchant service more than

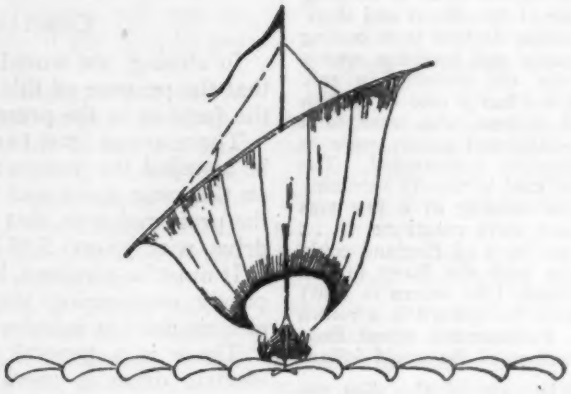
* Lieutenant (now Captain, Retired) C. H. Harlow, U. S. Navy.

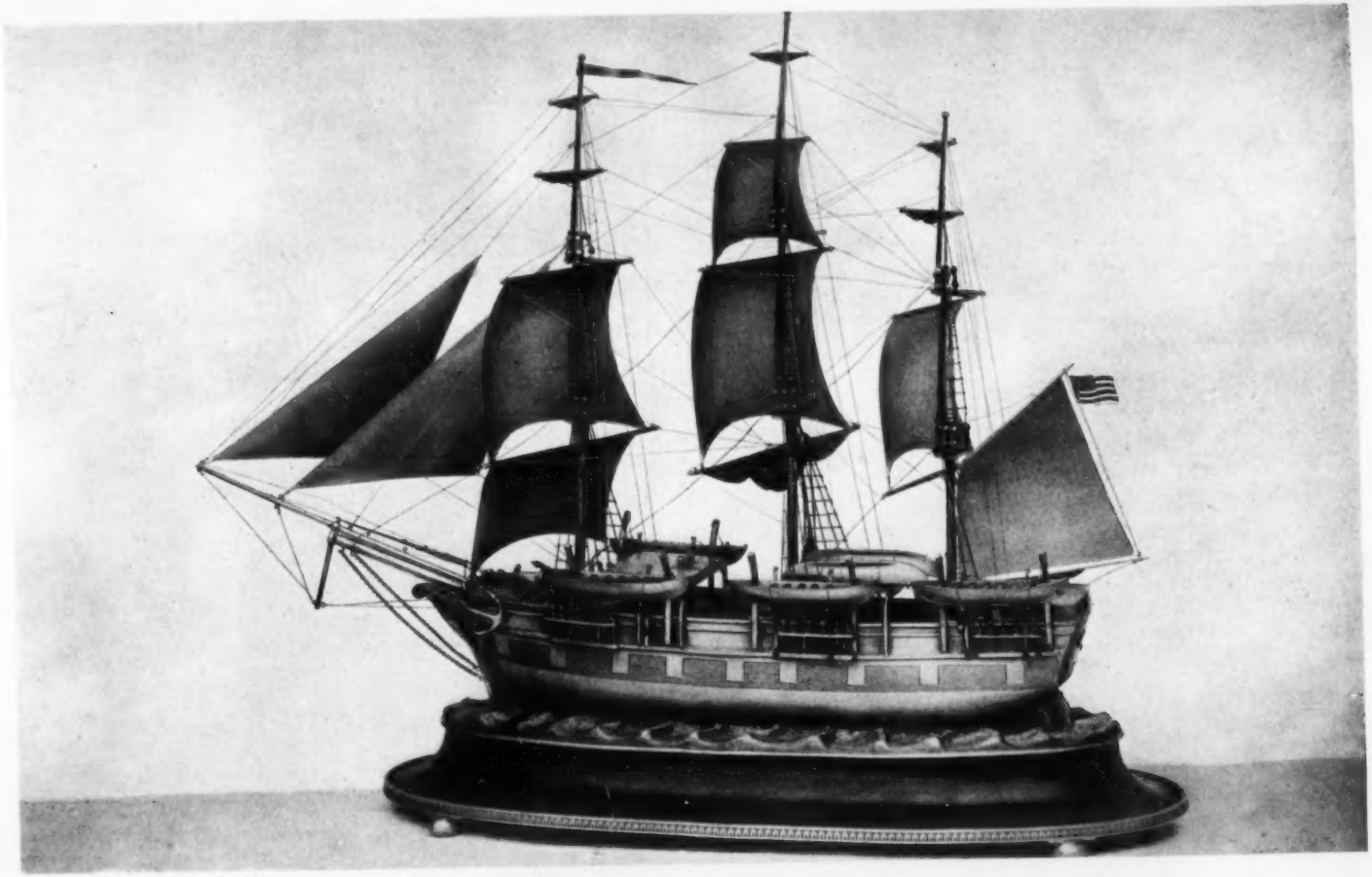
1,500,000 tons of motorships are being built because the owners have demanded it, and they have demanded it because they have been more impressed by the evidence of their own balance sheets and the reports of their own operating staffs than by the periodic attempts, based on assumed data, to prove that it could not be done. The Diesel engine will become available to the Navy when the operating branch demands it, and they will demand it when they realize that the great truth stated by Carnot is everlasting, and that, inherently, the Diesel engine is and will remain something more than twice as good as the steam engine.

AFTERWORD

The above was written during the month of August, 1928. At this time there seemed to be little chance that our prophecy made two years ago would become a reality.

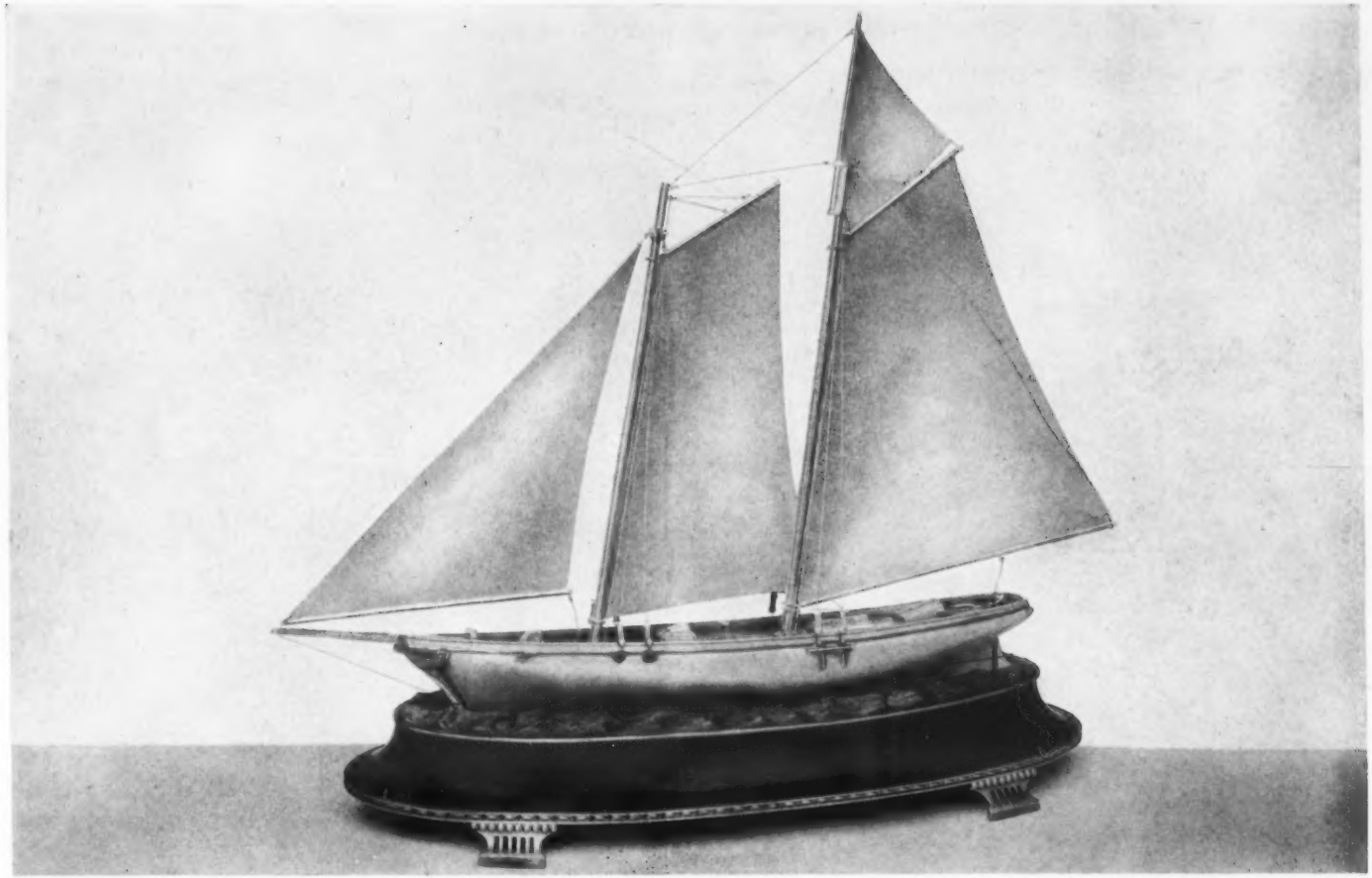
Since the above was written authentic information has become available that a German Diesel-driven warship of 70,000 S.H.P. was building. It may yet come to pass that the statement of our belief in the possibility of any ship laid down in 1925 becoming obsolete before completion was something more than a dream.





Courtesy Mr. Frederick R. Fish

MODEL OF U. S. S. *CONSTITUTION* IN SILVER
Four-sevenths actual size.



Courtesy Mr. Frederick R. Fish

MODEL OF YACHT *AMERICA* IN SILVER
Three-fifths actual size.

Three-fifths actual size.

Courtesy Arthur A. Tenney, C.E.

MODEL OF THE CHINESE EMPEROR'S BARGE (IN IVORY)

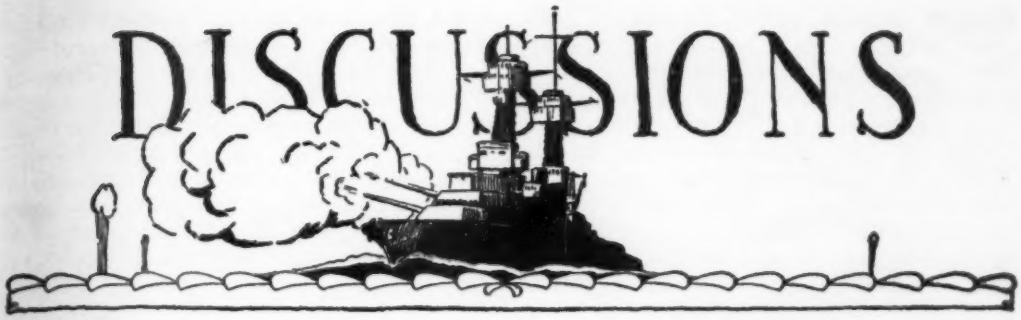
Not much is known of this model, except that it was brought from China about forty years ago, and is now located in the public library at Fitchburg, Massachusetts.

Pacific and Atlantic Photos

BLUEJACKETS IN THE PHILIPPINES

Examining an ancient means of transportation, the carabao.

DISCUSSIONS



THE "ERSATZ PREUSSEN"

(See pages 245-249 and illustration facing page 233, March, 1929, PROCEEDINGS)

MAURICE PRENDERGAST (Falmouth, England).—That the PROCEEDINGS should have devoted so much space, in the March issue, to a description and illustration of the *Ersatz Preussen* is highly commendable. It is hard to convey an impression of the immense sensation created over here in Europe by the appearance of this new German combatant ship. Some declare, here is a warship which marks the beginning of a new era in naval design, as did the British *Dreadnought* of 1906. Others ask if it is really worth while now to build 35,000-ton capital ships, considering that the Germans have erected a most formidable fighting *ensemble* on a basis of only 10,000 tons? Certain does it seem that the *Ersatz Preussen* will have a marked influence on past treaties and on future conferences for limitation of naval armaments.

She is a most interesting hybrid. What is her true rating or classification? A little faster is she than the fastest of modern battleships, the British *Queen Elizabeth* class; a little more weakly armed than any previous battle cruiser. She half beats the 1922 naval-treaty definition of a "capital ship" because: (a) she does not "exceed" 10,000 tons "standard" displacement; but (b) she does carry guns "with a caliber exceeding eight inches." To disguise her design the Germans (up to December, 1928) referred to her, indifferently, as "Kreuzer A" or as "The Armored Vessel" (*Panzerschiff*). In the 1929 (Jubilee) Edition of the German *Taschenbuch der Kriegsflotten* (Handbook of War Fleets), *Ersatz Preussen* is listed, illustrated, and described as an "armored cruiser" (*panzerkreuzer*). On the other hand, in the British Official White Paper "Return of Fleets, 1929" (compiled by the Admiralty) this same German ship is classified as a battleship. Britain and Germany can't agree about the rating; will America please arbitrate?

Some of the comments, reproduced in the March PROCEEDINGS, make very peculiar reading indeed. For example, certain critics think the *Ersatz Preussen* is simply a kind of "baby battle cruiser"; therefore she must inherit, in an accentuated form, all those defects in protection that led to the destruction of the British battle cruisers at Jutland.

But what have "defects in protection" to do with the loss of the British battle cruisers on May 31, 1916?

Take the recently issued Volume IV of *Naval Operations* (Corbett and Newbolt), and turn up pages 14 and 15, dealing with "Professional Opinion." It will be found stated there, that, immediately after Jutland, independent technical boards were set by the Admiralty and the Grand Fleet, to review and consider the lessons of the battle. After careful consideration, the Board of Admiralty accepted the explanations put forward by the director of naval construction (Sir Eustace Tennyson D'Eyncourt, K.C.B.), viz.: That the British battle cruisers *Queen Mary, Indefatigable,* and *Invincible* were not lost because their armor protection failed to keep out German shell. The three ships just named owed their destruction to the fact that, in an effort to keep up a high rate of fire, certain preventive and precautionary measures for the handling of ammunition were cast aside. In brief, the Germans did not blow up the British battle cruisers; the British battle cruisers blew themselves up!

After ten years statement and restatement, it has become almost an article of faith that

the German shell got into the vitals of these three ill-fated ships. To hear any contrary view now seems almost incredible. Yet here is the verdict given by those who had all the facts and evidence before them, immediately after the battle. Those who argue that the *Ersatz Preussen* must be inadequately armored, because the British battle cruisers at Jutland were deficient in protection, are quite adrift in their reasonings. The British battle cruisers were not so deficient and their armor withstood the ordeal by battle.

Is the Kiel-built German ship lacking in defense at all? I advance the view that, of all warships in the world, she is the one most invulnerably defended against all forms of attack. Comparisons between past battle cruisers and the new German armored ships are fundamentally unsound, and for this reason: they are comparisons between steam-driven capital ships and vessels that are to be driven by a new, featherweight type of Diesel engine. One might as well have predicted that Seagrave's "Golden Arrow" racing auto would never attain 200 m.p.h. on Daytona Beach, simply because steam-driven railroad engines never got anywhere near that speed in the past. Here, in a few lines, are comparative summaries of engine weights:

Name	*H.P. (designed)*	*Weight of Machinery (tons):*	*Lbs. per H.P.*
Hood (British)	144,000	5,350	83¼
Glorious (Brit.)	91,000	2,970	73
Lex. (U.S.)	160,000	6,172	76¾
Ers. Preussen (German)	50,000	(391?)	17½

REMARKS ON ABOVE TABLE

Hood: Weight estimated by present writer from percentage-weight (of normal displacement) for machinery, as given by Sir E. T. D'Eyncourt's paper, "H.M.S. Hood" (*Inst. Naval Architects,* London, 1920.)

Glorious: Weight of machinery from table given by the Italian constructor—Colonel E. de Vito—in article, "Possibilita techniche della nuova Flotta Germanica" (*Revista Marittima,* Rome, January, 1922). Machinery of *Glorious* was an enlargement of that in the British light cruiser *Champion;* hence reduction of weight compared with *Hood.*

Lexington: Weight is "wet" and refers to battle cruiser design and is taken from "Ships' Data: U. S. Naval Vessels, July 1, 1921" (p. 45.)

Ers. Preussen: Weight per H.P. as given by Hector Bywater, the *Engineer,* January 11, 1929 (quoted by PROCEEDINGS, March, p. 246. Weight of machinery estimated at 50,000 $\times 17.5 \div 2{,}240$.

I do not know if there was any very material change in machinery weights of the *Lexington* and *Saratoga* on their redesign for duty as aircraft carriers. (The only "Ships' Data" book I now possess is dated 1921, and was very kindly presented to me by the Bureau of C & R during my editorial connections with *Jane's Fighting Ships.*) However, suppose that the machinery weight of 6,712 tons still holds good. And suppose again that the *Lexington* (or *Saratoga*) could junk their steam-electric-drive plant and invest the same weight in Diesel engines of the new German type. Without an ounce being added to machinery weights, the power would be raised from 180,000 H.P. (steam) to 790,000 H.P. (Diesel)! I do not say such a conversion is a practical project; it is put forward to show that the Germans appear to be getting about four and a half times more power out of every ton of machinery weight than was got for the steam-electric-drive of the *Lexington* battle cruiser design.

Alternatively, if the steam-driven ships cited above were to retain their designed horsepower, but were to generate the same power by means of the new German Diesels, we get the following results: the *Hood* would develop her 144,000 H.P. with a saving of 4,224 tons in machinery weights; the *Glorious* would get her 91,000 with an economy of 1,360 tons, and the *Lexington* would still have her 180,000 but would pay 5,312 tons less for that power. Five thousand tons presented to the constructor, to play with as he pleases—to put into an immensely more powerful battery, or extra defense! Or he could cut his design by 5,000 tons, and still leave the ship as good as she was on a steam-driven basis!

It may be urged that the power-weight figure for the new German Diesels of *Ersatz Preussen* refer to main engines alone, whereas the figures for the steam-driven battle cruisers tabled above are "all-in" weights, inclusive of main *plus* auxiliary machinery. To such an objection, it may be pointed out that, by welding seams in place of riveting, use of high-grade steel, light alloys and castings, etc., the Germans have saved 550 tons (5.5 per cent of standard displacement) on hull weights alone. Surely a saving of 550 tons would not be entirely extinguished by weight of auxiliary machinery? However, let us henceforth discard the idea of compensations in hull weight. Let us make a

liberal allowance and say that the weight-ratio of main to auxiliary machinery (in *Ersatz Preussen*) is as two to one. Then the estimated "all-in" machinery weight is only 587 tons, or 36¼ pounds per horse-power. Had they used the *Lexington* (battle cruiser) type of steam-electric drive, the German designers would have required 1,713 tons to get their 50,000 H.P. On a very rough estimate, it would appear that the Berlin constructors have saved about 12.25 per cent of standard displacement in machinery weights, and 5.5 per cent in hull weights. What have they done with the 1,750 tons so set at their disposal?

The new German "panzerschiff" is such a freak that it is hard to find a mate for her. The nearest thing in design of the immediate past that we can find is the British light battle cruiser *Glorious* of 1916—18,600 tons (normal); four 15-inch, eighteen 4-inch guns; 31 knots; light armor. We have the weights for component features of the *Glorious*, but the snag is, they are all relative to her *normal* displacement, whereas we have only the 10,000 tons "standard" displacement of the German ship to work upon. However, we can establish the following approximate comparison between the two ships, estimating the *Glorious* to be about 17,750 tons "standard":

WEIGHT PERCENTAGES OF STANDARD DISPLACEMENT

Feature	*"Glorious"*	*"Ersatz Preussen"*		*Saving*
Hull	48	42.5		5.5
Machinery	16	5.9	(a)	10.1
Armament	12	10.6	(b)	1.4
Equipment	5	5.0		
	81	64.0		17.0
Available (both ships) for armor and protection	19	19.0		
	100%	83.0		17.0
Weight saved in *Ersatz Preussen* available for increased armor and protection		17.0		
		100.0%		

REMARKS

(a) Machinery estimated at
(i) main engines 50,000 B.H.P. at 17½ lbs. per B.H.P. ..... 391 tons
(ii) auxiliary machinery 50% of (i) above ..... 196 tons
587 tons
which appears to be a liberal allowance.

(b) Weight for armament of German ship reduced on these grounds:
(i) taking the broad rule that weight of guns varies as the cube of the caliber, the ratio of weight between the six 11-inch (*Ersatz Preussen*) and the four 15-inch *(Glorious)* should be as 8 (German) to 13.3 (British):
(ii) triple heavy gun mounts used in the German ship will be more economical of weight than the twin heavy gun mounts in the British vessel:
(iii) German "built-up" guns are lighter, caliber for caliber, than British wire-wound guns:
(iv) Secondary armament in German ship (four 5.9") smaller than in British ship (eighteen 4").

From the foregoing table—admittedly a very approximate one—it will be seen that the new "panzerschiff" can invest 37 per cent of her standard displacement in armor and protection. The *Hood* (one of the best protected capital ships in the world) could not allot more than (about) 33.3 per cent of her standard displacement to defense. Have the Germans actually endowed their new vessel with high resisting powers?

In the Reichstag, the German minister of defense (General Groener) said that, before the plans of the "New Armored Ship" were approved, the following requirements (amongst others) had to be completely satisfied:

(A) The ship had to be capable of striking a deadly blow at the largest and most formidable of foreign capital ships, in case of a surprise encounter under conditions of low visibility, as for example, in fog or at night.

(B) She was to be, so far as was possible, secure from loss by bombs, torpedoes, and mine.

The Germans declare that the *Ersatz Preussen* completely meets these demands. Thanks to an entirely new system of armoring, to massive deck protection, and to the most elaborate system of under-water defense ever incorporated in a fighting ship, they say that their new creation is the nearest approach ever made to "the unsinkable warship." And considering what a hammering their battle cruisers stood up to at Jutland, the Germans can speak with authority on the subject of ship defense. Does all this sound as if the *Ersatz Preussen* is a ship, inheriting "all those defects in protection that contributed to the loss of the British battle cruisers at Jutland"?

Two years ago, the Germans announced (in their naval budget) that very large sums were being expended on research with internal-combustion engines, with a view to using those motors for the drive of large surface warships. About a year ago, it became known that the Germans had worked out a series of alternative plans for "a small Diesel-engined capital ship of shallow draught and high speed." The question at once arose, how could they do it? If the ship were of shallow draught and large horsepower, the cylinder heads of the Diesels (if of the vertical type) would tower up high above the water line. If horizontal, opposed Diesels of the Junkers type were used, the ship would have an enormous beam. Yet the dimensions of the *Ersatz Preussen* were to be about 600 feet (water line) by 66 feet beam. How have the Germans met this obstacle? One who is exceptionally well-informed on German naval affairs gives me this explanation: The Diesels for the *Ersatz Preussen* (designed by the German Admiralty) are *not* the towering and slow-running, cumbrous type of motor, such as is now used for the drive of merchant ships. The new "Marine type" M.A.N. Diesels of the "panzerkreuzer" resemble the compact, low-built, fast-spinning type, such as have been used in the past for the surface drive of submarines. Although the hull is of shallow draught, the new Diesels can be stowed below the water line under double, heavy, antibomb decks. From the profile sketch of *Ersatz Preussen* (March PROCEEDINGS, p. 245) and from other information, it would appear that the two sets of 25,000 B.H.P. Diesels are set in tandem on the center line, possibly with electric drive of Föttinger hydraulic transmission.

On page 170 of Hector Bywater's *Navies and Nations* (British edition, 1927), there is a table showing the comparative maximum ranging powers of large-caliber guns mounted in United States and British capital ships. Take as data lines: (a) the 26-knot maximum speed of the German ship; and (b), the reputed 30,000-yard, maximum ranging power of her six 11-inch guns. What foreign capital ships are there capable of overhauling the German ship? And in the event of such a chase (given high visibility and over-horizon spotting), would the chasing ships have any advantage in ranging power over their quarry?

CAPITAL SHIPS OVER 26 KNOTS SPEED

Name	*Speed kts.*	*Guns main*	*Max. Range yds.*	± *on "Ersatz Preussen" Speed kts.*	± *on "Ersatz Preussen" Range yds.*
BRITISH					
Hood	31.0	8-15 "	30,300	+5	+ 300
Repulse ..	31.5	8-15 "	24,300	+5.5	—5,700
Renown ..	31.5	8-15 "	24,300	+5.5	—5,700
Tiger	30.0	8-13.5"	23,800	+4	—6,200
U.S.A.					
None					
JAPAN					
None. Of the four battle cruisers of the *Kongo* Class—*Haruna's* speed now reduced to 26 knots by additions of "bulges," etc. *Kongo* is being reconstructed as *Haruna*. *Hiyei, Kirishima,* to be taken in hand later for "modernizations" as carried out in *Haruna*.					

Nothing is absolute in war, and war's chances are not a matter of mathematics. As Captain Dudley Knox, U.S.N., points out in his Baltimore *Sun* comments on the *Ersatz Preussen* (PROCEEDINGS, March, p. 249), a 25-knot capital ship might be able to run down the nominally faster German ship, in a moderate sea. But ships like the two *Renowns* and the *Tiger* might be under fire from the German ship for twenty to forty minutes before they could close the range enough to open fire. And a large-caliber wallop near the water line, in the bows of a battle cruiser doing thirty knots or more, may cause chase to be abandoned. Recollect how the *Lion* was knocked out of the line in the Dogger Bank action!

And yet the Germans declare that this wonderful new warship of theirs is only built for *coast defense!* Was ever good wine so wasted by being poured away into the sand? I was surprised to see that the "Notes on International Affairs" in the March PROCEEDINGS embodied no summary of the famous "Secret Memorandum" on the *Ersatz Preussen,* prepared last autumn by the German Ministry of Defense. This memorandum is no longer "secret"; it has been translated and published by a British magazine (*Review of Reviews,* January 15, 1929). The Germans have never denied the authenticity of the British translation, of what has been described as "one of the most remarkable post-war documents ever published."

General Groener (minister of national defense) signed the confidential circular on "The New Armored Ship." The document

was a reasoned vindication of his government's policy in ordering the building of the ship. The minister set forth his arguments by proposing and answering questions such as these: (a) Will there be war? (b) Of what nature will that war be? (c) What part will the German fleet play in any future conflict? We can ignore all his discussion about the chances of another European war, or of a European alliance being pitted against the United States. He considers the real danger to be that of armed, land-grabbing raids. To prove the reality of such peril, he points out that, since 1918, Italy has seized Fiume, Poland has grabbed Vilna, and Lithuania has "jumped a claim" in Memel. Then he goes on to make the specific charge that Poland is preparing to raid and occupy the detached German province of East Prussia. (The Poles hotly deny any such intentions!)

If Poland makes the attempt suddenly, what chances have German forces on the spot of putting up a stand? Very poor, thinks General Groener. The German military forces in East Prussia are outnumbered by six to one by Polish army divisions just across the frontier. Under the Versailles Treaty, stocks of munitions in East Prussia are down to a dangerous level, and no resources for manufacture are allowed. When Poland makes the raid, she will be able to rush big supporting forces to military centers in East Pomerania. It is therefore very doubtful (says Groener) if troops from the Fatherland will be able to cut their way across the "Danzig Corridor," to get into the invaded province.

Therefore, if reënforcements and munitions are to be rushed into East Prussia, they must go by sea, under protection of the fleet. What has the present German fleet to fear from the insignificant Polish Navy? Nothing at all, and General Groener admits this. But, he says, a treaty exists:

> . . . . of which the terms are known to us, that engages France to support Poland, in the event of war, by a strong cruiser force in the Baltic. This squadron can, at any moment before Poland begins hostilities, pass under the Polish flag, without direct French participation in the war. At present we are weaker than a Polish fleet thus reënforced.

He goes on to say the new armored cruisers of the *Ersatz Preussen* class are urgently wanted, to neutralize the Franco-Polish cruiser squadron.

The great danger that the German general apprehends is that convoys of troop transports and munition carriers, rushed from Swinemünde to the East Prussian port of Pillau, will be subjected to night attack, confusion, and heavy losses. If the 230-mile run between the two ports can be made in daylight, the risk of loss will be much reduced. The new armored cruisers, if they are to act as convoy guardships, must therefore have a continuous sea speed of at least twenty-three knots. Otherwise, they are to relieve the army of coast defense duties in East Prussia, assist in bombardments of land targets, etc.

But if it is only the 230 miles between Swinemünde and Pillau that vitally matters, why have the Germans given their new armored cruisers a cruising range of 10,000 miles at twenty-nine knots? It indicates that in the background is some intention of ocean operations. One must not forget the circumstances under which the "Confidential Memorandum" was written. The Socialists and Communists were trying, by a national referendum, and by a resolution in the Reichstag, to throw the Müller cabinet out of office over the ordering of the "New Cruiser A." General Groener had the "Secret Memorandum" drafted, to convince the Socialist members of the Müller cabinet that the ship was vitally needed. Hence he played "the home defense" argument for all it was worth. The memorandum may therefore be no more than a piece of political propaganda, designed to swing the vote in the Reichstag, and save the cabinet. None the less, the French (so far as I am aware) do not deny that there *is* a "naval understanding" with Poland on the lines revealed by the German minister of defense.

Perhaps, at this point, some U. S. naval officer may ask, "What has all this to do with *us?*"

Just this—suppose you had to run and escort weekly, convoys of storeships and munition carriers from the eastern ports to Hawaii? Or, suppose there was a big fleet of troop transports to be convoyed safely to the other side of the Pacific? And suppose, lastly, that there was considerable danger of hostile cruisers, raiding and shooting up either class of convoy. Wouldn't you like to have at your disposal as "convoy guard ships," ten of these little German "huskies" that (*a*) can hurl out about eight

tons of 11-inch shell per minute, up to a range of 30,000 yards—a punch that would about send any raiding "tin-clad" treaty cruiser staggering to the ropes; (*b*) are heavily armored and virtually proof against loss by bomb, torpedo, or mine; (*c*) can run from Honolulu to Guam (or Samoa, or San Francisco) and back on a single load of fuel, and at a speed that would make them difficult targets to submarines.

One wonders if the new German "huskies" do, or do not, go a long way towards solving those "Problems of the Pacific" that have, hitherto, appeared almost beyond solution to outside observers such as we poor, benighted civilians are!

U.S.S. "Sirius"—Navy Cargo Ship

(See page 219, March, 1929, PROCEEDINGS).

EARLE FARWELL—Referring to the article in March, 1929, PROCEEDINGS entitled "U. S. S. *Sirius*—Navy Cargo Ship", it is no doubt desirable that a limited number of naval officers should have experience in handling a cargo ship. However, it is not possible to justify the operation of such vessels on the ground that there is a saving in cost to the government. It is stated that the *Sirius* during one year saved the government $116,954.30 as compared with commercial charges for transporting the same cargo and passengers. The only operating costs charged against the *Sirius* are maintenance, pay of officers and crew, provisions, fuel, supplies, repairs and stevedoring.

In addition to these items it is necessary, in order to reach the actual cost to the government of operating the *Sirius*, to include the following: depreciation on the value of the vessel, reserve equivalent to insurance on commercial vessels, use of piers and docks at navy yard, and overhead, including pay of officers and men ashore in connection with the operating of the ship and the assembling of cargo, preparation of reports, pay of checkers and other clerical work. There is, in addition, a direct loss to the government because the *Sirius* does not pay any Panama Canal tolls, whereas a commercial vessel carrying the same cargo would have paid tolls. There is a further loss to the government because a commercial steamship company would pay taxes. No allowance has been made for loss of or injury to cargo on account of which reimbursement would be obtained if the cargo were carried by a commercial vessel. The foregoing items, conservatively estimated, would be as follows:

Depreciation per annum	$30,000
Reserve in lieu of insurance	25,000
Wharfage and use of navy yard	10,000
Overhead	20,000
Loss of Canal tolls	25,000
Total	$110,000

Other losses and expenses, such as loss of taxes, injury to cargo, and other incidental expenses would exceed $10,000 a year.

It therefore appears that commercial transportation is cheaper. It may be asked how commercial vessels, when compared with the *Sirius*, can operate at a profit. The answer is that a commercial vessel of the same size would have a complement of about thirty-five officers and men, whereas the complement of the *Sirius* is 106. In addition, commercial vessels make many more trips during the year. The average time for a round trip from the east coast to the west coast for a commercial vessel is one hundred days. The typical voyage of the *Sirius* mentioned in the article began September 1, 1926, and ended February 8, 1927, a period of 161 days.

It is stated that the time charter rate of a commercial vessel would be $1,500 per day. If merchant vessels could be chartered at this rate steamship companies would be paying 20 per cent dividends. As a matter of fact, the charter rate is not more than $1.50 per dead weight ton per month. The *Sirius* is a 7500 d. w. t. ship and the daily time charter rate of such a vessel would be $375.00 per day.

Our merchant marine is having a sufficiently hard time as it is to operate profitably, and it would be most unfortunate if the government should compete with it to any greater extent than is now done. Incorrect statements that government operation is cheaper than private operation are harmful and should be corrected.

PROFESSIONAL NOTES

2 May to 29 May

Commander F. W. Rockwell, U. S. Navy
Lieutenant Commander A. C. McFall, U. S. Navy
and
Professor Henry Bluestone, U. S. Naval Academy

Great Britain
Cruisers and Gun-Power 628
Safety at Sea 629
Naval Aviation 629
Base versus Dockyard 629

United States
Vessels Under Construction 630
"Mallard" Raises Sunken Submarines 630
Proposed Expansion of Panama Canal 631

France
French Navy Notes 632

Merchant Marine
The United States Lines and the Navy 633

Engineering and Radio
Steam versus Diesel 633

Aviation
The Series C "Wasp" Engines 635
French Wind-Tunnel Methods 637
Flight of Diesel Engined Plane 638
New British Fighter to be Enclosed Type 640

Miscellaneous
Naval Disarmament Prospects 640
Smaller Spear-Heads 642

Current Articles and Books 644

GREAT BRITAIN

Cruisers and Gun-Power

Naval and Military Record, May 1.—The reasons why the British Admiralty are in favor of a smaller type cruiser than the 10,000-ton vessel representing the Washington maximum are not far to seek. The needs of the British Empire necessitate numbers, and, with economic conditions as they are nowadays, we cannot afford both size and numbers. Thus it was that in 1927 at Geneva, Mr. Bridgeman fought so hard for a compromise upon a smaller type of cruiser. The Admiralty have now substituted voluntarily a smaller 6-inch gun class of cruiser for the two vessels of the "B" class which were to have been laid down this year under the 1925 replacement program. Probably, it is true to say that, were this country in the same financial position as the United States, the Admiralty would not have done anything of the sort. We should not as a matter of mere unqualified choice elect to build cruisers of about 6,000 tons carrying 6-inch guns whilst other Powers were building cruisers of 10,000-tons carrying 8-inch guns.

Even wallowing in wealth as the United States is, there has been a good deal of outcry over the bill which will have to be footed as a result of laying down fifteen 10,000-ton cruisers within three years. From the tenders which have been thus far received by the Navy Department it seems clear that these vessels will not cost less than £3,200,000 apiece, which is just a round million each more than our own *Kent* class cost. The American ships will carry one more 8-inch gun than our vessels, but, so far as it is possible to judge, they will otherwise generally resemble them in salient details. Therefore we are led to the conclusion that warship construction in American yards is considerably more costly than it is in British shipyards, which, in view of the competition between the two countries to get orders from foreign naval Powers, is distinctly to our advantage.

In American naval circles the predilection of the British Admiralty for smaller, more lightly armed cruisers than the Washington type is hailed with satisfaction as likely to give the United States Navy a very distinct fighting superiority. Since war between these two countries is "unthinkable," we are not quite clear as to the value of such superiority. It would be ridiculous to dispute the fact that a 6,000-ton cruiser armed with 6-inch guns would be at a terrible disadvantage against a 10,000-ton cruiser carrying 8-inch guns. Yet this disadvantage boils down almost wholly to a question of gun power. In point of speed the two types may easily be equal. In point of protective qualities they probably would be equal. The question seems worth raising as to whether reduction in gun-caliber must necessarily accompany reduction in displacement. Reduction in the number of guns must certainly go with reduced tonnage. Our "A" cruisers mount eight 8-inch guns and the "B" cruisers six. Would it not be a wiser policy to give the new 6,000-ton type four 8-inch guns in preference to the larger number of 6-inch guns with which it is proposed to arm them? If a 6-inch gun were evolved of a range equal to the 8-inch gun the question need not arise, but there is no reason for anticipating that any such development is in contemplation.

Admittedly the smaller ship would be seriously handicapped by possessing only half the fire intensity of a 10,000-ton foe. But she would at least be able to hit back if attacked at long range, and it is not always the biggest expenditure of projectiles which produces the crippling result. A 6-inch gun cruiser would be outranged by an 8-inch gun cruiser, and we might anticipate a repetition of the conditions which resulted in the destruction of Cradock's squadron at Coronel. Down to the dreadnought era a main battery of four guns was considered sufficient for a capital ship. The late Sir William White designed big cruisers with only two guns (9.2-inch) for their main battery. Ten 6-inch guns would deliver a very much more "smothering" fire than four 8-inch guns, but, if that smothering fire fails to reach the adversary, it is of very little avail. Since all the other principal naval Powers have adopted the 8-inch gun for their new cruiser armaments, it appears rather a reactionary policy on our part to revert to the 6-inch weapon. To suggest that vessels so armed are designed for a particular rôle in which such armament is adequate is rather compromising with the question. Naval design should always keep abreast of foreign progress since our new ships must contemplate the possibility of being matched against the new ships of other nations.

Safety at Sea

Naval and Military Record, April 24.—The international convention in London upon the Safety of Life at Sea has naturally held considerable interest for the Royal Navy, even although mainly of a detached character. Warships are both constructed and equipped to a standard of safety which probably goes beyond anything likely to be proposed for mercantile vessels. But, apart from the question of comparative immunity from being sunk by collision or grounding (as distinct from becoming a total wreck by remaining aground), matters have been debated during the London Conference which equally concern all those who "follow the sea" in whatever rôle. The desire to attain international uniformity in the rule of the road, for example, will give satisfaction throughout the navigation branch. At present there exists a conflict as to the signification of helm orders which is not only confusing but may easily be dangerous in narrow, crowded waters.

Again, the proposals in connection with the use of wireless telegraphy by mercantile vessels are of importance to the navy. International uniformity in such matters as wave-lengths and signalling is more than merely desirable. To render any aid that may be possible to such vessels as may require it, irrespective of nationality, is an obligation recognized by all the principal navies. But the preliminary essential to receiving assistance is to be intelligible in summoning it. The S.O.S. is common to all maritime powers, but, when it comes to answering it and making inquiries about position and the character of the trouble, the result is not always as helpful as it might easily be—and, no doubt, will be—rendered by international agreement. Vice-Admiral Sir H. Richmond, as chairman of the British delegation, has excited considerable admiration throughout the conference, not only by the soundness of his judgment, but by the extent of his technical knowledge. In point of fact, he has a strong mechanical bent, and has long been associated with the development of warship propulsion.

Naval Aviation

The Engineer, April 26.—The failure of the Air Minister to secure control over all branches of the air service has been followed by a strengthening of the autonomy of the military and naval departments, which, while dependent upon the Air Ministry for the supply of machines, are taking their own initiative in all matters affecting the character of the machines required and the manner in which they are to be used. The technical work, however, is still centralized in the Air Ministry, and that lessens, somewhat, the force of the criticisms that are levelled against the separation of the services on the ground that an absence of unity is detrimental to the development of aviation. As a matter of fact, the naval department is endeavoring to make up for lost time, since, until two or three years ago, seaplane construction was quite neglected, and the work now being done promises, before long, to provide the fleet with an ample supply of efficient machines. It was this neglect of seaplanes in the past which was responsible for the failure to keep pace with some other countries in the organizing of services overseas, and while the navy is developing this type of machine for purposes of national defense the Air Ministry is preparing to bring out large commercial seaplanes which will allow of better services being carried out with South America and elsewhere.

Base versus Dockyard

Naval and Military Record, April 24.—Gibraltar remains—must always remain—of primary importance as a base, but is dwindling into disuse as a dockyard. Technically, of course, a naval base and a naval dockyard are quite separate and distinct. Portland, for example, the principal Channel base of the British Navy, has very limited resources for doing "little odd jobs." But then, it is within a very few hours' steaming of either Portsmouth or Devonport. Scapa, our great war base, had no shore resources for doing anything, but then it was within a very few hours' steaming of Rosyth. But all our principal overseas bases are dockyards as well. This is necessary owing to the fact that they are all so far from any regular dockyards. A warship torpedoed off the Shambles would probably be able to make either Portsmouth or Devonport if she were able to make Portland. But a warship torpedoed off Gibraltar, under the same conditions, might not be able to make Malta or Plymouth, and even if she were able to keep afloat, such a voyage for a wounded vessel in wartime would be extremely hazardous.

Therefore, our principal operational bases overseas are also equipped to serve as hospitals for wounded ships. When the great Singapore scheme was originally propounded it was explained that the Eastern base would be at one end of a strategical chain of which Gibraltar would be the other end. It does seem somewhat of an anomaly that, whilst the far end of the chain is being developed on the grand scale, the other end of it is being permitted to shrink to insignificance. We have heard it argued that Gibraltar is unsuitable for a dockyard since the place could be bombarded by modern long-range fire. If the artillery on the Rock is not adequate to enforcing the old precept that no warship should measure herself against powerful shore fortifications—and we cannot believe that this is the case—then it is high time that it was rendered so. The Grand Fleet never thought of attempting to bombard Heligoland throughout the war, although the place was a very active base for enemy light craft.

UNITED STATES

VESSELS UNDER CONSTRUCTION, UNITED STATES NAVY

Progress as of April 30, 1929

Type Number and Name	Contractor	% of Completion, May 1 1929		% of Completion, Apr. 1 1929		Contract date of Completion	Probable date of Completion
		Total	On Ship	Total	On Ship		
LIGHT CRUISERS							
Pensacola (CL24)	New York Navy Yard	74.3	70.7	70.7	67.0	7/ 9/29	2/ 1/30
Salt Lake City (CL25)	American Brown Boveri Elec. Corp.	87.9	87.6	84.2	83.8	7/ 9/29	10/ 9/29
Northampton (CL26)	Beth. SB Corp. (Fore River)	57.4	53.2	52.8	48.3	6/13/30	6/13/30
Chester (CL27)	American Brown Boveri Elec. Corp.	58.3	57.4	54.0	53.6	6/13/30	6/13/30
Louisville (CL28)	Puget Sound Navy Yard.	33.7	30.7	30.4	27.5	3/13/31	3/13/31
Chicago (CL29)	Mare Island Navy Yard.	33.2	25.7	29.4	21.1	3/13/31	3/13/31
Houston (CL30)	Newport News SB & DD Co.	54.2	51.4	50.6	46.4	6/13/30	6/13/30
Augusta (CL31)	Newport News SB & DD Co.	42.6	36.4	39.2	32.3	3/13/31	3/13/31
FLEET SUBMARINES							
V-5 (SC1)	Portsmouth Navy Yard.	62.	60.3	58.6	56.8		3/ 1/30
V-6 (SC2)	Mare Island Navy Yard.	54.6	50.9	50.8	47.		6/ 1/30

AUTHORIZED BY ACT OF AUGUST 29, 1916

12 Destroyers Nos. 348 to 359 inclusive—no funds for construction
1 Transport No. 2—no funds for construction
3 Fleet Submarines Nos. 169 to 171 inclusive—to be undertaken in fiscal year 1930
1 Neff Submarine No. 108—no funds for construction

AUTHORIZED BY ACT OF FEBRUARY 13, 1929

5 Light Cruisers—to be undertaken in fiscal year 1929
5 Light Cruisers—to be undertaken in fiscal year 1930
5 Light Cruisers—to be undertaken in fiscal year 1931
1 Aircraft Carrier—to be undertaken in fiscal year 1930

Mallard Raises Sunken Submarine

New York *Times*, May 22.—Using an SC tube, a non-electrical aquatic tube which picks up and magnifies sound waves in water, the first of the submarine rescue experiments conducted by the U.S.S. *Mallard* here, was declared highly successful today.

An official statement issued today by the Coco Solo submarine base reviewing the operations said:

"It is not believed that there will ever be any further trouble experienced in locating any sunken submarine."

The submarine *S-11* was sent into the Pacific Friday at 6:30 A.M. and theoretically sunk. The last word from it was received at 8:00 A.M., when the signal "Ready" was flashed to the "Rescue."

After using the oscillator for half an hour the submarine crew abandoned the control room and resorted to hammer tappings against the hull.

Upon receiving the distress signal the *S-*

12 and the *S-20* led by the rescue ship *Mallard*, went to the aid of the *S-11*. For half an hour the rescue squad cruised in waters where the *S-11* was last reported, when suddenly the *S-12* announced picking up sounds estimated at 3,000 yards from Toboguilla Light, near Taboga Island. Changing her course, the *Mallard* at 10:30 sighted air bubbles, and hooked a grapnel onto the submarine lying on the bottom off Taboga Island, and simulating helplessness.

An interesting feature was that of sending food into the submarine through a signal ejector, a gun used for firing signals when submerged.

Upon a signal tapped on the hull the outer door was closed and the inner door opened, making it a simple matter to obtain the food.

Only a slight amount of water was introduced into the submarine during this operation. The other operations included laying mooring buoys to bring the *Mallard* over the *S-11* and hooking up a salvage air hose to blow water out of the compartments and main ballast tanks. All of the operations were completed and the submarine raised at 5:00 P.M., nine hours after the distress signal was received.

All submarines at the base are to be rescued during the coming months."

Proposed Expansion of Panama Canal

Washington *Post*, May 19.—Steadily increasing traffic through the Panama Canal is hastening the day, still distant, when the big waterway will reach its capacity of traffic. But United States Army engineers already have plans laid which would make the canal adequate until the year 2060.

Present lockage facilities will take care of the traffic until 1960, according to estimates made by Governor Harry Burgess, of the Canal Zone, and Colonel Julian L. Schley, engineer of maintenance, provided a new water supply to be furnished through construction of a great dam in the Chagres River, fourteen miles away, is brought into it by 1940. The dam has already been authorized by Congress.

During the rainy season, from June to January, there is a surplus of water, the level of Gatun Lake rising to approximately eighty-seven feet above the sea. But in the dry season of four months the level of the lake drops down to eighty *or* eighty-one feet. Through the construction of the new dam a basin can be created where surplus water may be stored for the dry period.

Surveys show that a dam at Alhajuela, 170 feet hi h, in the Chagres River, will form a reservoir of some twenty-two square miles, which will provide 22,000,000,000 cubic feet of water. Actual work on the project began early this year when a highway was constructed from the canal to the dam site. This highway has been named "Madden Road" in honor of the late Martin B. Madden, member of Congress from the First Illinois District, who for many years was chairman of the House committee on appropriations.

It is estimated that the dam can be completed in five years, provided Congress appropriates the money with which to carry on the work without a break. The total cost is placed at $12,000,000.

Basing their estimates on the probable increase in world traffic, Governor Burgess and Colonel Schley believe that the present capacity of the canal will have been reached in 1960, when they figure that approximately 60,000,000 tons of shipping will be passing through the water way annually. This is about twice the present traffic. After 1960 they believe the canal must be enlarged.

This expansion, they declare, can be brought about through the construction of a third set of locks, parallel with the existing chambers. Drafts of this third set have already been prepared and the cost has been placed at between $75,000,000 and $100,000,000. These drafts provide for longer locks and chambers 120 feet wide, or ten feet wider than the present chambers.

The American airplane carriers *Lexington* and *Saratoga*, with a beam of 107.9 feet, passed through the canal early last year, but they had a tight squeeze, the clearance on each side being only 1.05 feet.

It is estimated that a third set of locks would carry all traffic offered for perhaps a century and that the waterway would be capable of passing 100,000,000 tons annually at that time. If a third set were constructed there would be two sets of chambers in continuous operation, even during the period of overhaul which comes every two years.

Each lock is given a thorough overhauling every four years, which necessitates the closing of one set of chambers for about

four months each two years. At present the locks on the Pacific side at Pedro Miguel and Miraflores are undergoing repairs, which makes it necessary to operate for twenty-four hours a day the remaining single set of locks.

The repairs, which have been under way since late in January, will cost approximately $700,000. No further overhauling will be necessary until 1931, when the Gatun locks on the Atlantic side will undergo repairs.

FRANCE

French Navy Notes

Naval and Military Record, May 1, by J. B. Gautreau.—Future wars will be a night affair. In the daytime the air, like the earth and the water, will tend more and more to be a "no man's land"—stillness, peace, and apparent sleep everywhere. So swift and deadly have modern weapons become that the target, safe when armoured, will lie in hiding under a natural or artificial cloak. Once this globe gets shrouded in its night mantle of darkness, the war area will all of a sudden spring into intense life, all available weapons being mustered simultaneously in the game of attack and defense or of strategic and tactical preparation. This means a revolution far greater and more far reaching than can possibly be realized at present. The chemical arm coming into full play, destruction will be wholesale and annihilation of the weaker side an ordinary normal ending to combined actions. Victory will next time go not to the side with the bigger ships, the heavier purse, or the larger population or resources, but to that side that will be the more up to date scientifically speaking and will have devoted the most time to the new methods of warfaring. Admiral Aube, who was so much derided in his time (just like his intellectual disciples Lord Fisher and Sir Percy Scott have been), will turn out to have been a prophet when he proclaimed some fifty years ago: *"L'avenir est à la vitesse, aux dimensions réduites, à l'invisibilité, à l'invulnerabilité, et à la spécialisation des batiments de combat."* Speed and mosquito size confer practical invulnerability to the fighting seaplane, and diving power renders submarines normally invisible, whilst camouflage and artificial clouds make other craft difficult targets in daytime.

Modern followers of Admiral Aube consider that if the great admiral were still among the living he would approve nothing beyond seaplanes and submarines, that possess practical invisibility and invulnerability, together with destructive power sufficient to account for the largest ships. Battleships, cruisers, and even destroyers he would condemn as being dangerous and useless, and little more than make believe. The gun he would do away with altogether as no longer answering any useful purpose, the bomb and torpedo being cheaper and more effective.

Such doctrines, however, although being hotly defended in some quarters, do not obtain much favor in responsible naval circles. Camouflage, that is becoming a "fine art," and artificial smoke or mist, as a series of realistic experiments have shown, may provide large ships with efficacious means of defense. When episodes of the last war are being rehearsed in those "Kriegspiele" that excite so great an interest among young officers, it is seen that many ships that fell victims to submarines would have escaped had they been able to throw in their wake or across their beams those up-to-date artificial mists that render impossible accurate "telemetring," spotting, and shooting. Moreover, mosquito aerial or submarine weapons, it is contended, are somewhat negative arguments in warfare and very incomplete. If they can occasionally destroy, they cannot conquer and impose their will upon an enemy. Their radius of action, even after recent improvements, is very limited, and they lack lungs and fighting endurance. Guerilla warfare and surprise operations are the only tasks they are adapted for. Now skirmishes can never determine success: something more is wanted to obtain the command of seas or of countries.

Cool-headed officers, whose habit is minutely to weigh facts and theories before diving headlong into the "realm of illusions," consider that recent scientific developments tend towards a revival of the battleship, stoutly armored, torpedo and bomb proof at least to a certain extent, designed for quick and smashing salvoes by guns of 12-inch bore (new quick-firing model), much on the lines of the British "Nelsons," but much smaller, with triple or quadruple turrets. Short and broad ships are advocated with a view to reducing the size of the tar-

get and rendering it unsinkable. The idea of semisubmersible cuirassés with high gun towers, as suggested by Admiral Degouy, though very tempting on paper, has been found after mature consideration to have doubtful value in practice save, perhaps, for coast defense operations. The German *Ersatz Preussens* of 14,000 tons, with their vast strategic possibilities when acting in collaboration with cruisers, torpedo craft, and seaplanes (especially since refuelling on the high sea has been made easy), are being considered as the prototype of the post-war battleship destined within some five or six years to discard all pre-war capital ships with the exception of the English *"Nelsons,"* so great is the progress taking place in the fields of ballistics and of armoring. With armorclads capable of firing volley after volley of six or eight closely-concentrated 12-inch shells at extreme range, unprotected or lightly-protected ships will have no place on the high sea. No wonder America is already preparing to replace her obsolete *"Floridas"* by battleships of the new type, to be ready for commission within five years.

MERCHANT MARINE

The United States Lines and the Navy

The Merchant Shipping Review, May—It is understood that the U.S. Navy Department is carefully scrutinizing the plans for the two new ships of 45,000 tons apiece which are to be built by the United States Lines under the agreement with the Shipping Board by which they obtained possession of the *Leviathan* and her consorts on the trans-Atlantic service.

These ships are to be of at least 45,000 tons, and it is anticipated that their speed will be at least 25 knots in order to permit them to compete with the *Mauretania* and the new Germans. It is quite likely that they will make an effort to win back for the United States the Atlantic Blue Riband, which they have not held since the 'fifties. The American Navy is to have a considerable say in their design, presumably for the purpose of using them as auxiliary cruisers in the event of war.

But the experience of the British and German Navies in the late war was most emphatically that such express liners were of little or no use as auxiliary cruisers, and although large sums had been paid in subsidies for Atlantic greyhounds from the 'eighties onward they were all paid off and used as hospital ships or transports after a few weeks' experience. The *Mauretania* was commissioned as a cruiser, but it was very speedily found that it was quite impossible to keep her in coal so that she was returned to the company after many thousands of pounds' worth of damage had been done to her expensive fittings. Later she was most successful as a transport and hospital ship.

The Germans commissioned the *Kaiser Wilhelm der Grosse* as a cruiser, but she was destroyed by a very inferior British ship when her bunkers were swept clean and she did not do nearly as much damage to British commerce as the 10-knot *Moewe* or *Wolf*. There are rumors afoot that the U. S. Navy is trying to evolve a design whereby it can use these new ships as auxiliary aircraft carriers, in which they might be very much more useful. Such a plan, however, is likely to bring about an interesting position with regard to the Washington Agreement limiting that type of ship.

ENGINEERING AND RADIO

Steam versus Diesel

The Nautical Gazette, May 18.—While the battle still rages between steam and Diesel, it is particularly interesting to review the facts and figures given last month by Mr. Johnson, superintendent engineer of the Canadian Pacific Steamships, regarding the high-pressure turbines installed in the *Duchess* and *Beaver* ships of his company. His address was delivered before the Institute of Naval Architects in London.

At the time the two *Duchess* boats had each traveled about 34,000 miles. The average speed had been above the contract figure. No boiler, condenser, or super-heater troubles had been experienced. Since three or four main steam-pipe joints were remade no trouble was experienced. Ample elasticity through corrugated bends and avoidance of water accumulation are important. The consumption of fresh water for make-up feed is only thirty-five tons per day or about half that consumed by engines of old design. On opening of boilers after two voyages a light deposit of ferric oxide dust was found and removed.

It is possible to expect that the boilers can be steamed for six months without brushing the interior surfaces. The cost of cleaning the water side of the boilers has averaged only about $50 per voyage.

Quotations at the time the *Duchess of Bedford* was ordered showed that quadruple screw propulsion by single-acting two-cycle eight-cylinder Diesel motors would have cost £100,000 more, which means an additional annual capital charge of £15,000 for interest, depreciation, and insurance. The relative cost of boiler and Diesel oils and the cost of repairs are factors awkward to handle in making comparisons. Although much is said about the Diesel's advantage in weight of bunkers, a true comparison should include the combined weight of the propelling machinery, fuel and feed water. Based upon a 6,000-mile voyage the total weights show about 300 tons in favor of steam in an 18,000 s.h.p. vessel. In this connection we believe it might be interesting to make comparisons with the light-weight high-speed Diesels recently developed for use with reduction gearing or hydraulic couplings.

Mr. Johnson allows £200 per voyage for engine repairs, making £2,200 per year for the eleven voyages. This added to the £2,800 for the annual Board of Trade inspection totals £5,000 per annum. Allowing 25 years for the life of the vessel and taking an "ultra-cautious" view of possible replacements, he estimates for renewals every seven years: Condenser tubes, £7,000; superheater tubes, £3,600; air-heater tubes, £2,400, and bottom rows of boiler tubes, £3,300. These amount to approximately £2,000 per year, which brings the total for repairs to about £7,000. Inasmuch as the fuel costs for the steam job in the North Atlantic and the Pacific would not be greater than Diesel fuel costs, allowing for consumptions and differences in price, Mr. Johnson considered it was not necessary to go into the cost of repairs for Diesels, which, in fact, he continually avoids. As usual, no definite generalization can be made, as, of course, much depends upon the differences in bunker prices at the different ports. But when Mr. Johnson uses San Francisco, where the differences between Diesel and Bunker "C" oil are small, the prices being 33 and 30 shillings, respectively, the fuel costs work out: Steam, 121 tons per day at 30 shillings or £182; for Diesel, 92 tons, all purposes, at 33 shillings, or £152. For 200 days steaming per annum the difference of £30 per day in favor of the Diesel amounts to £6,000. This added to the £7,000 for repairs totals only £13,000. It is not clear about just how much extra cost for fuel consumed by the steamer in port is allowed, although a total of £8,800 in fuel costs in favor of the Diesel is allowed in Mr. Johnson's paper, which figures boiler and Diesel oil at exactly the same price, which is indeed liberal to the Diesel.

But, again, in the beginning it was not stated by Mr. Johnson what kind of engine-room and deck auxiliaries were included in the quoted price for the Diesel ship which exceeded the *Duchess of Bedford's* price by £100,000. Were they to be electric or the same steam auxiliaries as on the *Duchess* boats? Naturally it makes quite a difference in port consumptions, as well as first costs. At any rate the argument is that the £7,000 for repairs and the £8,800 for extra fuel exceeds the annual capital charge of £15,000 on the Diesel by only £800, and the conclusion is that "as the cost of lubricating oil for a Diesel installation is certainly in excess of this figure, the cost of repairs may again be left as an unknown surplus."

From the viewpoint of many shipowners, engineering personnel and repairs are two big factors to be considered in motorships. While Mr. Johnson's figures and remarks may not be wholly convincing to the Dieselites, the practical assurance of economies and ease of reliability make a good case for steam, and Mr. Johnson proves his points.

Even if the economics of high-pressure modern cargo steamships and motorships ranging between 4,000 and 10,000 s.h.p. be fully explored, Mr. Johnson claims that in the majority of cases the advantage lies with the steamer, this condition holding when the steamer is using oil as fuel, the extra cost of boiler oil only being slightly higher than the annual capital charge on the extra first cost of the motorship. "It is evident, therefore, that if the steamship is also able to use coal in zones where its price is attractive, a strong superiority obtains with that type of installation."

It is then pointed out that in spite of apparent difficulties it remains for the naval architect to design deep tanks that might be used for either coal or cargo, and double-bottom tanks for either oil or ballast. And

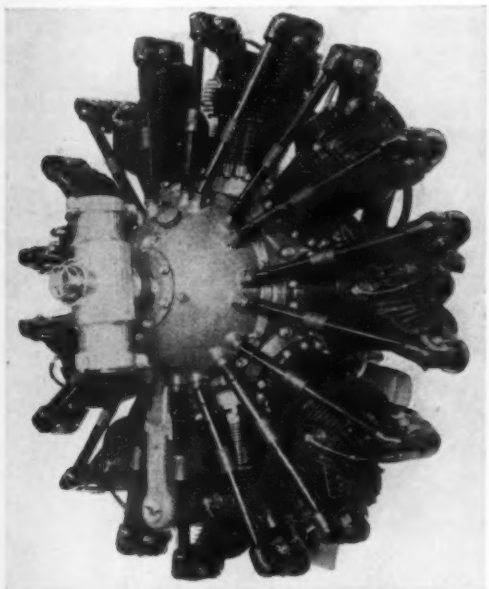
it is up to engineering initiative to arrange boilers and firerooms so that either pulverized coal or oil may be safely used.

As to the future, Mr. Johnson thinks that fuel oil consumption of .55 pounds for all purposes may be expected. When it is considered that not much better than .45 pounds per s.h.p. for all purposes is done by Diesels, except possibly those built with the Buchi system, the recent advance of steam seems startling. Nevertheless, it is not probable that Diesel designers will stand still, and there still seem to be many who believe that a way will be found to practically utilize pulverized coal or a by-product of coal in marine Diesel cylinders. As most of our readers know, Dr. Diesel's original engine was designed to burn coal gas, but the advent of oil facilitated the development of the Diesel because of its liquid state.

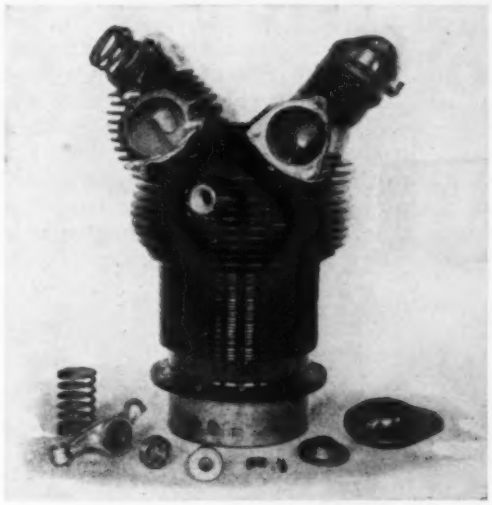
AVIATION

The Series C "Wasp" Engines

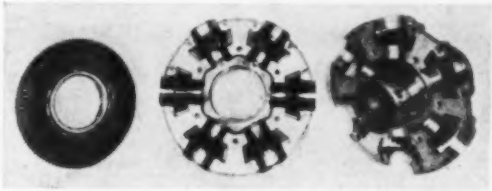
Aviation, May 18, 1929.—A new "Wasp" engine embodying several modifications in the design of previous models, has been placed in production by the Pratt and Whitney Aircraft Corporation of Hartford, Connecticut. This engine, which is designated "Series C," has a commercial rating of 420 hp. at 2,000 r.p.m. and a military rating of 450 hp. at 2,100 r.p.m. Geared and supercharged models as well as the direct drive type are available.



The Series C engine has passed a number of flight and dynamometer tests to the satisfaction of the manufacturer. As a final check an official fifty-hour Navy test was run during which the engine developed an average of 465 hp. at an average speed of 2,080 r.p.m. The average fuel consumption was 0.524 lb. per b.hp.hr. and average oil consumption 0.014 lb. per b.hp.hr. The dry weight of this engine was 684 lb., giving a weight per horsepower of 1.47 lb.



THE VERTICAL FINNING AND THE NEW STYLE OF ROCKER ARM AND BEARING



THE PATENTED 2:1 REDUCTION GEARING WITH THE AUTOMATIC EQUALIZATION DEVICE

Throughout the test no repairs or disassembly inspections were made. The engine was operated at full throttle for the entire period. Power as well as fuel and oil consumption remained practically constant throughout the fifty-hour test. At the conclusion of the test the engine was completely disassembled for inspection. It was found that all parts were in excellent condition and that it was only necessary to replace

three piston rings and two valve springs to put the engine in first-class condition again.

One of the important modifications in the Series C Wasp engine is the improved cylinder head design which involves a new method of finning. On account of the improved cooling, the life of the cylinder head, as well as of the exhaust valve, has been considerably lengthened. A change has been made in the shape of the exhaust valve which further increases the length of life of these parts. More rigidity has been provided in the crankshaft through a redesign which increases the diameter of the

THE FORGED ALUMINUM SECTION OF THE NEW WASP SERIES "C" RADIAL AIR COOLED ENGINE

crankpin and the thickness of the crank cheeks. The rocker arm design has been changed so that the four bearings supporting it are carried in the rocker instead of in the cylinder. This arrangement facilitates the removal of the rocker arms and better provides for retaining the lubricant in these bearings. On both military and commercial engines a slipping member has been interposed between the crankshaft and the impeller drive to relieve the drive of accelerating and decelerating stresses. A forged aluminum nose section is now being used instead of the casting formerly employed. This is practically twice the strength

REAR QUARTER VIEW OF THE ENGINE SHOWING ACCESSORIES

with a little less weight. Steel drive gears have been substituted for duralumin in the magneto and pump drives. This provides for a much longer life for these parts. Reduction in operating cost has been achieved by modification of the master rod bearing which now has a life of from two to three times that of the original type.

The increase in performance is attributed by the manufacturer to the improvement in cylinder cooling. A new type of hot spot combined with a preheater eliminates ice formation and provides the proper distribution in cold weather. Modifications in the carbureter give much better acceleration.

THE CRANKSHAFT ASSEMBLY OF THE NEW SERIES PRATT AND WHITNEY ENGINE

Among the miscellaneous improvements is a large oil sump which obviates any possibility of oil accumulating in the lower cylinders while the plane is at rest. Provision has been made for greasing the top of the push rod by means of a drill hole from a Zerk fitting on the rocker arm axle. The intake pipe flanges have been improved by a stiffening bead around the edge. A drain plug has been provided in the sump to permit of draining the oil at this point. A steel liner has been placed in the nose section to carry the thrust bearing.

None of the features embodied in the original Wasp models have been discarded. All of these have been retained such as the forged aluminum main crankcase, enclosed valve gear carried in patented integral housings on the cylinder head, one-piece master rod and divided crankshaft as well as rotary distribution and location of all accessories at the rear of the engine.

The supercharged model has the same sea level rating as the unsupercharged military engine. The supercharger is designed to render the sea level power available up to 5,000 ft. Several patented features are embodied in the geared model which is only slightly heavier than the direct drive type. After a long series of experiments a bevel type of two to one reduction gearing has been developed with automatic equalization of the pinions so that each carries its proportion of the load.

Improvements have been made not only in the design of the engine but also in the fabrication and testing of its parts. In an effort to produce high quality equipment, an extremely rigid test and inspection system is employed. A single standard of quality is maintained for both military and commercial products. An engine picked at random out of each lot is given a fifty-hour type test as a check on the fabrication and inspection methods. This insures a thoroughly tested and proven product.

French Wind-Tunnel Methods

The Aeroplane, April 24.—M. A. Lapresle's lecture before the Royal Aëronautical Society on April 11 on the apparatus and methods in use at the Eiffel Laboratory now under the control of the French *Service Technique,* was especially interesting as supplying a contrast to the apparatus and technique in use in this country for similar purposes.

The laboratories as developed by M. Eiffel at the Champ de Mars and at Auteuil are of the open-jet type, such as we in this country do not use at all. In the United States an enormous twenty foot tunnel of the open-jet type has been built which is particularly useful for *ad hoc* research on fullsize machines and for aërodynamic measurements on fullscale airscrews, there being no tunnel wall interference.

The open-jet type of tunnel is so called because a jet of air is sucked across the test-chamber by means of entrance and exit cones and a fan. This allows plenty of room and ease of access to the test subjects and supporting apparatus.

M. Lapresle read the introductory paragraph of his paper, after which Major A. R. Low, who had very kindly translated the paper, read the lecture and explained the large number of slides which were shown.

The first laboratory was built at the Champ de Mars, Paris, by M. Eiffel in collaboration with the late M. Leon Rith, but this was superseded by the Eiffel laboratory at Auteuil in 1912. Although detail improvements have appeared step by step, yet no real principle has appeared to upset M. Eiffel's technique of wind channel measurement. A large number of slides were then shown which illustrated the various pieces of apparatus in use and the interior of the laboratories.

The paper then went on to describe and illustrate the apparatus used in the experiments on aërodynamical stability of an aëroplane and the velocity field round an aërofoil.

The same apparatus is used to determine pitching stability and directional stability. The apparatus designed for the investigation of rolling stability has not yet been completed. In the first two cases mentioned above the method is essentially the same, the model being mounted on pivots so that it may rotate, about the requisite axis passing through the C.G. of the full-scale machine, the pitching or other moment of the machine being balanced by a small plate attached to the pivot which mounts the model, and set normal to the air-flow. This plate is previously calibrated. By moving the plate along its arm and noting from a divided scale at the base of the pivot the

incidence of the model, readings are obtained which may be plotted at once giving the pitching moments as functions of the incidence. A similar method is employed for investigations of directional stability.

The whole frame which carries the pivot-mounting is hung on gimbals through the axis normal to the pivot-mounting. By rotating the frame on these gimbals it is possible to investigate pitching moments at any angle of yaw and to investigate directional moments at any angle of pitch. The whole thing seems simple and ingenious. The rapidity of the determination is also attractive.

A number of graphs plotted by these methods and used for determinations of tail-plane, rudder and fin areas were shown and explained.

Coming to the determination of a velocity field round an aërofoil, the lecturer described how a pitot tube bent at right angles was used. By such means and turning the head through 180° both pressure and velocity may be determined.

A number of charts plotting the curves of equal velocity and showing the airflow past the aërofoil were explained. A novel point raised was that a suitable place for airspeed pitot heads or venturi tubes was a point above the trailing-edge where the disturbance of the velocity is very small. Small windmills placed on the wings and used for driving electric or other equipment may be subjected to velocities of more than 30 per cent above the undisturbed speed for which they are designed. In front of the leading-edge a region is noted where the velocity is considerably less than that of the undisturbed stream. This fact may explain certain discrepancies noted in the working of air-screws placed before very thick wings. The paper concluded with an account of the exploration of the wake behind the wing and suggesting a means of calculating the mean deflection of the stream meeting the tail-unit.

In the discussion which followed Captain Goodman Crouch spent a busy time translating the members' queries and remarks to M. Lapresle and then translating M. Lapresle's reply, all without any hesitation or delay.

Flight of Diesel Engine Plane

New York *Times*, May 19, by T. J. C. Martyn.—The flight last week of an airplane powered with the first aëro Diesel engine marks a milestone in the history of aëronautics, just as the invention by Captain L. M. Woolson of the Packard Motor Company of the engine itself will go down as one of the great aëronautical achievements.

The plane, a Stinson-Detroiter, in six hours fifty minutes flew from Detroit to Langley Field, Virginia, a distance of about 650 miles—an average performance, considering the adverse weather, for a machine of its class. Its engine, however, was based on the principle of the oil engine invented in 1900 by Dr. Rudolf Diesel, a German, and consumed about fifty-four gallons of furnace oil as against some ninety gallons required by an ordinary gas engine. The cost of this consumption was computed at $4.68 as against $26.85 for gasoline.

Not much is known about the engine. For the present most of the details of its construction are being kept secret, principally on account of patent difficulties. The Packard Company is certain enough of the qualities of the engine to arrange well in advance for its quantity production. The engine has nine cylinders, each working independently of the other. This means that there are in effect nine engines in one. The type is radial, offering rather less head resistance than the average radial gas engine. Beyond that little is known.

The advantages of an aëro Diesel over a gas engine are enormous; it is difficult to say where they end, for it is not impossible that the use of these engines as they are developed, may affect the design of airplanes. The greatest advantage, doubtless, lies in their use of crude oil, which is combustible only under great pressure. This means that the fire hazard is removed—a tremendously significant result. Although accidents caused by fire are relatively few in number, there is a larger proportion of accidents which terminate in fire, and this menace is ever present. To do away with it, therefore, is not only to stimulate public confidence in aërial travel, not only to add a new factor of safety to the airplane, but to give commercial aviation an even sounder basis for development.

Then comes reliability. A Diesel engine is a very simple mechanism, built very strongly to withstand high pressures and thrusts. Compared with the ordinary gas engines there are few things which can go

wrong with it, and of these few a breakage is most likely, but not the most probable, on account of its structural strength. Given the fact that the Packard motor has nine independent cylinders, it is seen at once that engine failure is virtually ruled out of the picture—one of aviation's afflictions.

The question of economy is at present most impressive. The Packard aëro Diesel uses approximately 40 per cent less fuel than a 200-horsepower gasoline engine. We may regard this as a more or less constant figure. The fact that furnace oil, which it burns, is more than twenty-one cents cheaper, impressive though it is, is an inconstant saving; for as the demand for this type of fuel increases it is obvious that the price may increase. However, the increase should not be so great, for the refining process would remain largely eliminated and other costs could hardly rise to a point where gasoline prices now stand. Conceding, merely for the sake of example, that furnace oil should one day be 30 cents a gallon, there would even then remain a saving of 40 per cent in consumption.

The problem of designing an aëro Diesel engine has for long been before aëronautical experts and motor engineers. That an engine which has earned such universal renown on the seas as the Diesel should not be susceptible of modification for use in an airplane was unthinkable. But the engine has to withstand tremendously high compression and has to be solidly built to prevent premature explosion. When these engines were first used they rated about fifty pounds per horsepower and the average is now about seventeen pounds—obviously far too heavy for a plane, which requires a motor weighing not much more than three pounds per horsepower, and has available engines weighing slightly under two.

However, until fairly recently, no experiments for Diesel-type motors were made, so far as is known, with new highly stressed metals, such as the hard aluminum alloys, chrome nickel and high-tensile steel. It was felt that if these were used wisely a satisfactory light-weight Diesel-type engine could be evolved. This is apparently what Captain Woolson has done, in addition to adapting the Diesel to the radial type; and it is indeed an enviable feather in America's aviation cap, for there are several foreign competitors experimenting in the same field.

The principles of the Diesel motor are exceedingly simple. In reality it is what is known as a compression-ignition engine. If you take a combustible mixture and compress it hard enough it will explode of its own accord, without any need of an electric spark. The ignition, then, is by compression.

Each cylinder is essentially an independent member of the engine. There is no carburetor to supply a mixture to the unit as a whole; there is no ignition system. In an electric-ignition internal combustion engine the failure of the carburetor or the magneto will put the whole motor out of action. Moreover, the compression-ignition engines have no complicated intake and exhaust systems and no spark plugs to go wrong.

Take the cylinder of the Diesel type of engine as the unit. It has one valve, which acts both as an air inlet valve and an exhaust outlet. The piston draws air into the cylinder chamber on its downward stroke. The valve closes. The air is then compressed very highly. When the cylinder is somewhere near the top of its stroke a jet of heavy oil is shot into the chamber, to mix with the compressed air. Further compression takes place and the explosion occurs naturally at the top of the stroke, driving the piston downward and providing the power. On its next upward course the dead gas is driven out of the valve and fresh air sucked in.

In the Packard compression motor there are nine of these independent cylinders. If one should go wrong, the other eight would still continue, in all probability without much loss of power, and it is even possible that four cylinders would produce enough power to keep a plane in level flight at low altitudes. The compression in these nine cylinders is quite evidently so high that starting the engine by hand is out of the question, and as it has no electrical system, an electric self-starter is likewise ruled out.

The absence of electrical equipment is a feature of considerable importance. Not only does it eliminate such paraphernalia as dynamos, magnetos, plugs, batteries, wiring, coils, distributors and what not, but it lightens the load to the extent of the weight of these articles, and their total weight is heavy. Then there is a great benefit to radio communication in the absence of the electrical equipment.

New British Fighter to be Enclosed Type

New York *Times,* May 24.—After two years of experiment and development Royal Air Force designers have turned into practical effect what they call the greatest lesson learned from Colonel Charles A. Lindbergh's flight across the Atlantic in the *Spirit of St. Louis,* and the result is a new secret fighting airplane in which the pilot sits in an entirely enclosed cockpit.

When aviation engineers examined Colonel Lindbergh's plane after his arrival at Croydon they declared there was little to learn either from the construction of his monoplane, from his navigation instruments, which enabled him to keep such a remarkably true course, or from his engine. What interested them most was the fact that Colonel Lindbergh had shown so little physical fatigue, although he was not, from outside appearance at any rate, a particularly robust man.

They came to the conclusion that, apart from Colonel Lindbergh's grit, his amazing skill as pilot and as "natural" navigator and the reliability of his entire equipment, the success of the flight was in no small measure due to the design of the plane's cabin. Colonel Lindbergh sat there entirely protected from the elements, almost "blind" as regards direct forward vision, but in a flush of fresh air free from exhaust fumes and almost free from engine noise. No British fighting aircraft then constructed provided the pilots with any real protection. Although Colonel Lindbergh and other pilots engaged in commercial flying at moderate altitudes were protected, men who were engaged in duties at heights measured in miles were exposed, head and shoulders, to Arctic temperatures and blinding gales, deafened by the noise of super-engines and at times almost overcome by their fumes.

Air Force designers set to work and the result has been seen in recent secret tests of what may be described as the world's first salon fighting aircraft. The pilot is entirely enclosed in a cabin of nonsplinterable glass so treated as to prevent it from becoming frosted over in high altitudes. His position is so arranged that there is no "blind spot" and, by some means not disclosed, he is able to manipulate his machine-guns with the same accuracy as if in an ordinary fighting machine.

Technical men are convinced that the war in the future will be fought in the rarefield air of the upper atmosphere and the nation possessing aircraft that protect the pilots against the extremes of temperature and physical distress, it is contended, will have won half the battle at the outset.

MISCELLANEOUS

Naval Disarmament Prospects

The Engineer, May 10.—The question of naval disarmament has once more assumed topical importance in view of the speech delivered by Mr. Hugh Gibson, the United States representative, before the Preparatory Commission on Disarmament at Geneva on April 29. No country in the world is more interested in this question than Great Britain, to whom adequate naval power has been for many centuries the first condition of security and prosperity—nay, of very existence. It is, however, not surprising that the initiative in making a fresh move towards the restriction of combatant fleets should have been left to America. Since the abortive Geneva Conference two years ago there has been a very general feeling here that little was to be gained by making new overtures to the United States in regard to ths particular problem. To speak frankly, the American attitude at Geneva was not encouraging, while the reception accorded at Washington to the tentative Anglo-French naval compromise last year was accepted as evidence of America's disinclination to reopen the subject of naval limitation, except at her own selected moment. Judging from Mr. Gibson's speech, that moment has arrived. Congress in the interval has authorized a great ship-building program, which, if carried out, will give the United States a definite lead in heavy cruiser strength. Moreover, there has come into office a President who, having traveled extensively abroad, has a wider experience of foreign countries than the majority of his predecessors enjoyed. We may take it that Mr. Hoover appreciates the many-sidedness of the naval problem, and realizes that it is much too complicated to be solved by a stroke of the pen. So much may, indeed, be inferred from the speech of his representative at Geneva, which expressed a readiness to modify the American attitude that was responsible in part for the failure of the last Conference.

Unless a spirit of give and take prevails, conferences on disarmament are not merely useless, but positively harmful. That spirit was not conspicuously present at the Geneva gathering in 1927, and the breakdown that followed has had an undesirable effect upon Anglo-American relations. It is a platitude that friction between nations is almost always due to mutual misunderstanding, but in this particular instance the homely truth needs to be emphasized. Until quite recently, at any rate, public men in America evinced no understanding of the British position in regard to naval armaments. They persisted in treating the naval situations of the two countries as analogous, whereas they are fundamentally different; they worked out a formula of relative strength sufficient for American requirements—which, in sober fact, are much more limited than our own—and then, when Great Britain declined, politely but firmly, to accept a demonstrably inadequate allotment of naval power, accused her of imperialistic tendencies, and threatened to punish her by building a fleet of such magnitude that she would be relegated to second place in the naval hierarchy. In England, on the other hand, there has been a marked failure to comprehend the American point of view. That the United States, with its population of 120 millions, its enormous industrial capacity, its thriving and increasing foreign trade, its boundless wealth, and, above all, the commanding position in world affairs which it has come to occupy, should desire to be worthily represented at sea is surely natural enough. From the dawn of civilization, naval power has been at once the symbol and the concrete expression of national aggrandisement, and in deciding to cultivate this power the United States is only following the historical example of other nations, England included. It is of the first importance that British public—and official—opinion should understand that the United States in aspiring to become a maritime power of the first order, is simply obeying the irresistible impulse of destiny. Equality in sea strength as between the two nations was agreed upon at Washington nearly eight years ago. Previously, America had been building sixteen great capital ships, which would, it was claimed, give her absolute supremacy afloat. In view of the concurrent programs of Great Britain and Japan, which included ships superior in tonnage and armament to the American vessels, that claim was exaggerated. Unfortunately, however, the American people have been encouraged to believe that they voluntarily sacrificed naval primacy in the cause of disarmament, and, further, that the machinations of other powers, headed by Great Britain, have rendered their sacrifice futile. The facts are very different. Great Britain has scrupulously observed the Washington Treaty, both in letter and spirit. Since the Washington Conference she has been progressively reducing her naval forces. Even the modest five-year replacement program enacted in 1925 has been drastically pruned. But our example has not been followed elsewhere. Foreign naval expenditure has steadily increased, while ours has steadily declined. Since the Treaty was signed the United States has legislated for twenty-three cruisers of 230,000 tons; within the same period the British Empire has provided for twenty cruisers of 190,000 tons. In proportion to the pre-treaty ratio, the fleets of Japan, France, and Italy have all been substantially enlarged. Great Britain has consistently advocated reduction in the size of warships. The United States, on the other hand, has held out for maximum dimensions. In the light of these facts it is manifestly absurd to accuse us of hampering the progress of naval disarmament. It now appears that the United States is willing to give favorable consideration to those questions which it has hitherto refused to discuss, namely, the reduction of warship dimensions and the devising of some formula which, while maintaining the "parity" principle, would enable Great Britain to make reasonably adequate provision for the protection of her far-flung trade communications. There is as yet no sign of America's willingness to accept a lower cruiser standard than the 10,000-ton 8-inch gun type, but it is suggested at Washington that the factors of displacement, age, speed, armament, and radius might be weighed when assessing tonnage quotas. That is a very sensible proposal. The bulk of our cruiser fleet consists of small and lightly armed ships, many of them prematurely aged by the rigors of war service. It is unfair to class such vessels as equal to the new 10,000-ton cruisers, yet they are invariably so classed by American propagandists.

When the United States has completed its current program, it will possess thirty-three big ocean-going cruisers, an aggregation of fighting force much superior to the British cruiser fleet, in spite of the latter's superiority in numbers. It remains to be seen whether the United States, in its desire to promote further naval restriction, will agree to limit the number of 10,000-ton units, and, when that limit is reached, accept a smaller type of ship as the common standard. That, we consider, is the only possible method of achieving true cruiser equality. The argument that America, owing to the paucity of her oversea bases, must have very large cruisers, while the British Empire, which has numerous fuel stations abroad, only requires small cruisers, is entirely fallacious, while the further contention that Britain's fleet of liners must be reckoned as potential cruisers in any scheme of limitation is irrelevant. Such arguments may be useful for propaganda purposes, but it is to be hoped that they will be excluded at the next naval conference, where their introduction could only lead to barren and perhaps acrimonious controversy. According to news from Washington, American naval authorities are prepared to discuss a reduction in the battleship standard established by treaty. Great Britain has twice proposed a maximum of 30,000 tons for future ships, instead of the existing limit of 35,000 tons, and a lowering of the gun caliber from 16 inches to 13.5 inches, but until recently there had been no response from America. The approaching end of the "naval holiday" invests this question with importance, for unless the treaty is modified in the interim we shall have to lay down two battleships in 1931, and the prospect of expending £8,000,000 on each ship will not appeal to the taxpayer. It is to be noted that in the advance American Navy estimates for the next financial year provision is made for beginning two battleships, unofficially stated to be of 35,000 tons, with nine or ten 16-inch guns. There are, we understand, very few naval officers who seriously contend that 35,000-ton ships are necessary.

It must be admitted that the obstacles in the way of a new naval agreement calculated to give universal satisfaction are still formidable enough. They are not necessarily insuperable, however, and if, as now seems evident, the United States intends to cooperate with this country in the friendliest spirit, there is little doubt that the combined influence of the two leading naval powers would overcome all difficulties. Nothing would contribute so much to international harmony as a definitive settlement of the naval issue as between Great Britain and the United States.

Smaller Spear-Heads

Naval and Military Record, May 1, by Sir Herbert Russell—A short time ago Captain J. V. Creagh, D.S.O., in the course of a lecture at the Royal United Service Institution, expressed the belief that we should witness the advent of a very much smaller type of capital ship. This opinion, coming from a member of the Naval War College and an officer of such known ability, interests me not a little. Perhaps I shall be pardoned for admitting that it interests me the more since I have been saying the same thing for some years past. Captain Creagh mentioned a ship of about 10,000 tons displacement, with internal combustion engines, capable of voyaging from England to Australia upon her unreplenished fuel endurance. He clearly had in mind the much-discussed new type of German "pankreuzer"; in fact, if I remember aright, he definitely referred to her, not necessarily as an ideal prototype, but as an example of what has now become mechanically possible upon a displacement of 10,000 tons—or call it 12,000 tons by the formula in use before the Washington Agreement.

Captain Creagh did not go into the question of the influence upon the accepted principles of battle tactics which such a new type of vessel might be expected to exercise. It is possible that he sees no reason to believe that she will influence these principles at all. But General Groener, the German Minister of Marine, thinks otherwise. In expounding the particular features of this new type of battleship he said that we should never again witness grand actions between great masses of ships, such as Jutland. The sea war of the future would be much more mobile. This is a doctrine which is bound to challenge controversy.

For almost as far back as I can recall the governing principle in battleship design in this country has been to produce a ship cap-

able of beating the enemy. As a principle it is sound enough. But the inevitable result of it was to develop intensive competition. We took longer and longer leaps with each successive stage. But throughout there was a school of thought which quietly questioned the wisdom of this policy, and wondered whether, indeed, we were actually producing ships which were sure to beat the enemy. It is now widely recognied that mere size is not a guarantee of invincibility. The designer will be able to give you more of everything in mere size, and what is called the material school cries "Encore!" The tactical school wonders how it is going to apply more of everything to definite advantage. For the limit has remained in the matter of sea-keeping endurance, and the mammoth fleet must deliver its coup within three days' steaming or not at all.

A battle fleet is manifestly intended to counter an enemy battle fleet in whatever manner that may be used. If it is not used actively at all, then it can only be dealt with by the containing tactics of "silent pressure." I agree that we must not argue upon the strategical possibilities of the next sea war from the experiences of the Great War. Such geographical conditions, so localized and so entirely in our favor, are not very likely to be repeated. Let us assume a sea campaign of which Singapore is the hub. It may be a ridiculous assumption, in view of the present-day trend of international feeling upon the whole subject of war. But as Singapore is being developed into a first-class base, and as we possess a battle fleet and there are other world powers possessing battlefleets, such a conception is not an impossibility. Nothing is impossible as long as the means for materializing it are in existence.

The battleship is the material expression of the old "slogan" that our business in the event of war is to "seek out the enemy and destroy him." That tradition dates from an era when it was a perfectly feasible proposition; when we were strong enough as a naval power to carry it into effect and when a battle fleet could keep the sea until it had grown green whiskers upon its bilges. The battleship remains the primary weapon of destruction. Her rôle is to smash the enemy or, conversely, to prevent the enemy from smashing any of our lighter ships by the process of denying him the sea. The combined exercises in the Mediterranean this year were planned so as to furnish the battleships with an opportunity of demonstrating their capacity to fulfil their traditional functions. But there was this one element of unreality in those exercises: they pre-supposed a willing enemy, an enemy perfectly ready to join action. All experience teaches that in actual warfare such a situation is extremely improbable. One side is very much less inclined to accept battle than the other, probably for perfectly legitimate reasons. And the problem, which is involving the whole question of the value of the battleship, is as to how the reluctant side can be forced to conform to the purpose of a stronger or a more determined enemy. Time was when the answer to this question lay in the close blockade, for bottling-up is as effective, if not as satisfying, as forcing out. Nowadays, limited sea-keeping endurance, submarines, aircraft, and mines render active blockading, out of the question. Passive blockading, of the character which the Grand Fleet exercised from Scapa Flow, is only possible under abnormal geographical conditions.

The small battleship capable of voyaging from England to Australia without fuel replenishment opens quite a new orientation. She is, in reality, a cruiser with the gun power of a battleship, and she may undertake functions which it would never be contemplated to assign to the ponderous ship-of-the-line. Most of the discussion regarding the new German type has centered in the potentialities of such vessels as commerce destroyers. That they would be capable of infinite mischief in this capacity is self-evident, because they are too heavily armed to be dealt with by any class of ship that we have evolved for commerce protection. Supersubmarines suggest themselves as the best type of craft for dealing with such commerce raiders. But my immediate point is that the very fact that these new German vessels are being widely discussed as potential trade raiders, although they are designed as battleships, illustrates the current vagueness of vision as to the rôle of the capital ship. The prospect of guerilla warfare opened up by the advent of this new type of warship must give rise to some hard thinking. If we concentrate our capital forces against the vulnerable points of an enemy zone it would seem to follow that

he must concentrate his capital forces to protect himself. But if he possesses a great strength in submarine, such concentration on our part is going to be a pretty risky business. True, all war is risky, particularly modern war, and sheer audacity may win through where calculating prudence results in exactly nothing. But as against this concession to the "Nelson touch" it must be remembered that concentration in an enemy zone is not a matter of "daring dash and then away," but a grouping of vessels in a very active hostile area, where they must remain if they are to achieve any definite purpose.

The real question is as to how far the material change in the character of the battleship, as illustrated by the new German type, will produce a tactical change in the conception of her functions. The new German type will be able to do a good many things which the great armored ship could not undertake. How far will she attempt to exploit her capabilities? Obviously, the answer must largely depend upon the character of the war. If we are going to follow the German lead and build 10,000-ton capital ships, the other first-class naval powers are going to do the same thing, and so the principle of similarity of weapons will be maintained. But the transition will involve a change of combatant potentialities, the possibilities of which none can as yet foresee.

If history repeats itself, such a tremendous swing-back in the size of battleships will be a new starting point in competition, unless another Washington Conference puts a stop to this which, judging from the present "atmosphere," appears rather unlikely. Rivalry will take the stereotyped form of increasing gun power, speed, and fuel endurance. But the material results of such competition are likely to be slow, by which I mean to say there will be nothing like the tendency to jump in big stages as in the past. Science is always working in the direction of getting more efficient results upon smaller measurements. Thus it is stated that the type of gun which the Germans will mount in their new ships will have a range almost, if not quite, equal to our 15-inch gun of 1913. This may or may not prove correct; what certainly is correct is that the new German gun will have a range quite adequate to any possibilities of using it in battle. This being so, what is the value of the much bigger and heavier gun when balanced against the much increased displacement involved by its adoption? And, after all, the gun should have some relation to the target against which it is designed to be employed. We have reached a 16-inch weapon in the progressive effort to ensure the smashing of steadily-improving armor. A 10,000-ton ship cannot be armored with anything like the same degree of massiveness as a 35,000-ton ship. Changed conditions of warfare have brought about a considerable modification of view as to the value of broadside armor. So long as the conventional conception of a sea action was limited to a duel of direct fire, the case for broadside protection was quite clear. But in this age of plunging fire, torpedo fire, and aerial bombing, the whole problem of effective resistance has assumed new aspects.

These are technical questions for the naval designers, and have only an indirect relation to the tactical considerations suggested by the idea of a reversion to battleships of 10,000 tons with the unprecedented capacity of being able to voyage half around the world without stopping. One result of such a change would be a tendency towards the simplification of types. To go on building cruisers of the same displacement as battleships would be an anomaly for which the only justification could be a vastly increased sea-keeping endurance. Maybe the Admiralty, with a prevision for which they are not yet receiving credit, forsee the coming change (a change which must take a good many years to run its course) and that this is the explanation why they have deliberately reverted to a cruiser design of about 6,000 tons and an armament of 6-inch guns.

CURRENT ARTICLES AND BOOKS

"Uncle Sam's Chinese Patrol"—by Oliver McKee, Jr., in the *National Republic*, May, 1929.

"Diesel Cruiser Upsets World's Naval Plans"—by R. H. Ward, in the *World's Work*, May, 1929.

"Soundproofing of Airplane Cabins"—Bureau of Standards, *Journal of Research*, May, 1929.

"I Like Diving"—by Tom Eadie.

The following articles are found in *Brassey's Naval and Shipping Annual* for 1929:

Naval Section

"Naval Forces of the British Empire."
"Foreign Navies."
"Comparative Strength and Distribution."
"Historical Observations on Japan's Naval Policy."
"Naval Policy of the United States."
"The Geneva Conference and After."
"Post-war Developments in Naval Machinery."
"The Submarine Mine."
"Contemporary Naval Literature."
"Marine Aviation.'

Merchant Shipping Section

"Ten Years' Shipping Progress."
"Liner and Cargo Vessel Experience in 1928."
"Standing of the World's Merchant Fleets."
"Is the World's Shipping Trade Reviving?"
"The Imperial Shipping Committee."
"The American Merchant Marine."
"Marine Machinery."
"The Bauer-Wach Exhaust Turbine System."
"Notable Merchant Ships of the Year."

Profiles and Plans

"Capital Ships, Cruisers, Torpedo-Boat Destroyers, Merchant Ships. (Profiles)."
"Dimensions and Particulars of British and Foreign Warships."
"Ships of the Lesser Navies."
"British and Foreign Flotillas."
"Tables of Comparative Naval Strength."
"Plans of British and Foreign Warships."
"Ballistics of Guns of Principal Powers."
"Expenditures for Naval Purposes of the Principal Foreign Powers."

Merchant Shipping Reference Section

"Merchant Shipping Tables."
"Largest Merchant Shipping Vessels of the World."
"Freight Rates."
"Fastest Ships of the World."
"Fastest Voyages of Principal Passenger Steamers."
"Motor Ships."
"Development of Marine Propelling Machinery."
"Marine Engine Construction."
"Progress in Marine Machinery."
"Foreign Trade of Great Britain and United States."
"Entrances and Clearances in all Countries."
"Canal Traffic."
"Distances in Nautical Miles from Port to Port."
"List of Bunkering Stations."
"British Naval and Shipping Organizations."
"Colonial and Foreign Technical Societies."

NOTES ON INTERNATIONAL AFFAIRS

From May 3 to June 3

Prepared by Professor Allan Westcott, U. S. Naval Academy

ARMAMENT REDUCTION

To Study U. S. Naval Reduction Plan.—The Preparatory Commission for a Disarmament Conference, which was in session at Geneva during April, adjourned indefinitely on May 6, primarily for the purpose of giving the chief naval powers an opportunity to study the American formula for approaching the problem of naval reductions, as set forth in general terms by the American representative, Ambassador Hugh Gibson. It was generally believed that the commission would not meet again until autumn, though, meantime there will be further exchanges of opinion among the naval powers, with prospects that each will put forth its own formula, or a modification of the American formula adapted to favor its own interests.

In the April session Ambassador Gibson expressed willingness to explain the American formula in detail to any nation interested, but there was a marked reluctance on the part of other powers to make inquiries, and the explanatory memorandum prepared by Admiral Jones was not called for and not made public. So far as the British were concerned this hesitation was no doubt largely due to the impending home election, and the unwillingness of the British delegate, Lord Cushendum, to make any move which would hurt the chances of the Conservative party. With the subsequent victory of the Labor party in the elections of May 30, there will doubtless be a much greater show of eagerness on the part of the British to coöperate.

Accomplishments of Conference.—During its April session the Preparatory Commission went over nearly all the sections of their draft convention for a limitation of Armament Conference, leaving the naval section as the chief one still unconsidered. Although the Soviet delegate, M. Litvinoff, declared that the commission had made progress simply by removing from the draft convention "all the important clauses which had formerly evoked controversy," prospects for a general conference were brought somewhat nearer, with the possibility that it might be held in the latter part of next year. Notable among the concessions made was that of Ambassador Gibson declaring the United States would no longer oppose the exclusion of trained reserves from army limitation, followed by a French concession, favorable to the United States, withdrawing the rigid French plan for international supervision of disarmament.

The American concession had immediate results, the commission removing from the draft convention not only limitation of "trained reserves" but also limitation of military supplies, except by publicity as regards expenditures. In the loudly expressed opinions of the Soviet and German delegations, this action destroyed all hope of a real solution of the disarmament problem.

President Hoover on Arms Reduction.—Speaking at Arlington on Memorial Day, President Hoover by his warm en-

dorsement of the Gibson proposals at Geneva showed clearly that these expressed the policy of the Hoover administration. He declared that all nations could show effective loyalty to the Kellogg Peace Treaty by putting their armaments on a strictly defensive basis. While our own country must have "adequate preparedness" as insurance against aggression, he added that "limitation upward is not our goal, but actual reduction of existing commitments to lower levels."

American Gains in World Trade.—Increasing influence of the United States in world trade and finance was emphasized in England during the election campaign, and was stressed by the directors of the Westminster Bank (London) in their current review of trade conditions, summarized as follows in the American press of May 22:

A close examination of the geographical distribution of American and British exports, says the *Review*, shows that since the war America has gained much ground, while Great Britain has lost much ground in practically every important buying market.

"Whereas foreign commerce is still regarded in the nature of a by-product of America's economic activities, it is vital to Britain's existence. Britain now exports between 25 and 30 per cent of her products, which is lower than pre-war. On the contrary, in America exports represent 9.6 of the 'exportable' production of the country. Therefore, for America, the export trade is a desirable side line rather than an urgent necessity. It has done no more than to keep pace with the production of the country as a whole. It is concluded, therefore, that the possibility of a great American export drive arising out of the saturation of home markets cannot be regarded as imminent."

Britain's policy, adds the review, should be directed to increasing her trade in the world as a whole, rather than with a deliberate design of countering a sudden and irresistible growth of American competition.

REPARATIONS AGREEMENT

Accord Reached.—After another month of perplexed wandering in a maze of figures during which the failure of the conference was averted only by the most patient and persistent efforts of the American chairman, Owen D. Young, the conference of experts at Paris on June 1 at last reached full agreement on the amount of reparations to be paid by Germany and the conditions of payment. Only one point was left unsettled—the redemption by Germany of the marks put in circulation in Belgium during the war, after seizure of Belgian gold and paper money—and it was hoped that a decision might be reached on this point also before completion of the final report.

The annuity terms agreed upon were practically those suggested by Mr. Young in his last compromise proposals. Germany will pay for thirty-seven years an annuity increasing from 1,708,000,000 to 2,400,000,000 marks, but averaging 2,050,000,000 marks put in circulation in Belgium during for twenty-one years an annuity of 1,700,000,000 marks, or about $408,000,000, will be paid to cover the allied debts still due the United States and the remaining claims of the United States against Germany. The money for this later annuity, however, will come from a special sinking fund built up by allocation of 80 per cent of the profits of the International Bank of Payments.

Of the German payments, $158,400,000 will be "unconditional," and thus capable of conversion into negotiable bonds. The first annuity will date from April 1 of this year, but will be covered until September 1 by payment of $288,000,000 under the Dawes Plan. One request of Germany was refused—that she be allowed to transfer the debts due her from the successor states to the Austro-Hungarian Empire and from Poland as payment of the last twenty-one annuities. Of the mobilizable part of the annuities France will receive 500,000,000 marks (about $120,000,000).

American Concessions.—As a small indication of American eagerness to further in every way possible the Paris debt negotiations, President Hoover, after a hasty conference on May 19, cabled the American representatives that the United States Government would consent to certain concessions in the matter of American claims against Germany payable under the Dawes Plan. These total only about $350,000,000, of which $207,000,000 is for the cost of

American forces of occupation, and $143,000,000 for settlement of mixed claims. The concession made was not in the total amount but in the annual payments, which were reduced about 10 per cent, their duration being correspondingly increased.

This friendly gesture was possibly intended to counteract the effect of the rather stiff announcement of the U. S. State Department, a little earlier, that no American official could "directly or indirectly participate in the collection of German reparations" through the proposed International Bank, that having been the unvarying policy of the American government since the war. Americans may no doubt still participate as private individuals.

GREAT BRITAIN

LABOR GAINS IN MAY ELECTION.—With but thirteen districts missing, the results of the British parliamentary elections on May 30 indicated a decisive victory for the Labor party, with 288 seats in the new Parliament as compared with 252 Conservative, fifty-six Liberal, and seven scattering. As indicated by the figures, however, a Labor ministry if organized under the Labor leader Ramsay MacDonald will not have a clear majority, but must depend on support from the small group of Liberals and independents, with the possibility that a new election may be necessary in the autumn. No governmental reorganization was anticipated before the meeting of Parliament on June 25. The probable advent of a Labor ministry will mean a considerable shift in British foreign policy, and especially in Anglo-American relations, Mr. MacDonald having declared that better relations with the United States, including a naval agreement and settlement of the issue of "freedom of the seas," would be one of the cardinal aims of a Labor administration.

Although Labor secured a plurality of seats in the new parliament, the popular vote was distributed roughly as follows: Conservative, 8,656,000; Labor, 8,383,000; and Liberal, 5,217,00; the Liberals making a 30 per cent gain over 1924.

ITALY

RATIFICATION OF VATICAN ACCORD.—The Italian Chamber of Deputies on May 14 and the Senate ten days later gave practically unanimous approval to the Lateran Treaty between the Holy See and the Italian Government, and King Victor Emanuel III signed the agreement on May 27. The treaty will go into effect immediately upon the completion of ratification, which was expected early in June.

SOVIET REPUBLIC

MEETING OF SOVIET CONGRESS.—The annual session of the national Soviet Congress opened at Moscow on May 20, and went through the formality of approving the five-year industrial program and the plan of "rural socialization" put forth by the Soviet leaders. Little opposition was expected from the "Right" faction led by Bakunin and Tomsky, with which Rykoff was also suspected of having sympathy. Among the measures favorable to the peasants introduced in the Congress was one by Rykoff removing restrictions on religion. Possibly as a reproof for this manifestation of liberal tendencies, though ostensibly to relieve him of multitudinous duties, Rykoff was removed from his position as Chairman of the Council of Commissars (premier) of the Central Soviet Republic, though he still remained Chairman of the Council of Commissars (premier) of the all-Russian Soviet Union of Republics.

LITTLE ENTENTE STILL HOSTILE.—At a conference of the Little Entente nations held at Belgrade in May, Roumania and Jugoslavia defeated a proposal of Czechoslovakia for joint recognition of the Soviet Republic. Roumania insisted that the Soviets must first renounce all claims to Bessarabia, while Jugoslavia was still apparently guided by her loyalty to the old imperial Russia. The Little Entente powers renewed their treaties of alliance which would have expired on June 1.

LEAGUE AND WORLD COURT

COUNCIL MEETING AT MADRID.—No change was made in plans for the League Council session set to meet at Madrid on June 6, in spite of the fact that the British representative, Sir Austin Chamberlain, would no longer represent the party in power at home. The chief business of the Council was to consider a report on League

protection of minority populations, prepared by a committee consisting of Sir Austin Chamberlain, Senor Quinones de Leon of Spain, and M. Adatchio of Japan. The report of this committee, it was stated, would reject most of the proposals made by Germany and Canada for more rigorous League supervision of the treatment of minorities, while providing for an increase of the Minority Committee from three to five.

It was expected that the Council would take up the Root formula regarding American adhesion to the World Court, as approved by the committee of jurists, and would recommend it for adoption by the member states.

LATIN AMERICA

TERMS OF TACNA-ARICA SETTLEMENT.—In view of the important part taken by the United States in efforts at settlement of the long-standing Tacna Arica dispute, it was a matter of both courtesy and propriety that President Hoover should announce, on May 17, the terms of agreement finally reached by direct negotiation between Chili and Peru. According to these terms, Chili retains Arica, including the city of Arica, the chief port of the two provinces. Peru secures Tacna, together with all public property in that province and a payment from Chili of $6,000,000. The boundary between the two territories will run just north of the railway from Arica city to La Paz, Bolivia. A monument commemorating the settlement will be erected on a promontory near Arica. Though the agreement must still be approved by the legislatures of the two countries, there appears to be good prospect of its final ratification.

Direct negotiation between Chili and Peru began last September, after renewal of diplomatic relations in July. Much credit is due ex-Secretary of State Kellogg for his persistent efforts to bring a peaceful agreement, after failure of the attempted plebiscite, and the final solution is substantially that which he proposed. In announcing the settlement, President Hoover was careful to make clear that it did not constitute an expression of opinion on the part of the United States Government as to what a just settlement should be. This was perhaps in deference to the claims of Bolivia, whose hopes for a sea outlet were quite disregarded in the division between Chili and Peru. Hence also the announcement of the Bolivian minister in Washington that the "historic problem of the Pacific" is still "far from solved."

BOLIVIA-PARAGUAY DISPUTE.—That the Chaco quarrel between Bolivia and Paraguay may yet come before the League of Nations appeared again possible when the Paraguayan Minister in Paris on May 13 sent to the League Council a note complaining that Bolivia was concentrating troops in the Chaco region and preparing for surprise military action. The Bolivian Foreign Office sent to the League Secretariat a few days later an extended denial of the charges. Slight encounters between military forces of the two countries have occurred recently in the disputed territory, in one of which a Bolivian soldier was wounded.

ASIA AND FAR EAST

FENG'S WAR ON NANKING.—Renewed confusion in China and civil war on a grand scale were made certain by Marshal Feng Yu-tsiang's formal announcement on May 24 of war on President Chiang Kai-Shek and the "illegal" government at Nanking. This open break was preceded by a month of messages, proclamations, and accusations, in the course of which Chiang expressed unwillingness to believe Feng's disloyalty and invited him to a conference at Nanking. To this Feng's reply was a public statement attacking Chiang for corrupt use of funds and abuse of power. Later, on June 1, Feng sent a telegram to Nanking, hinting that the war situation had reached a stalemate, and suggesting that he would leave China for a period of years if all members of the "Soong Dynasty"—including President Chiang himself; T. V. Soong, Finance Minister; and H. H. Kung, Minister of Commerce and brother-in-law of the two others—would consent to resign and quit China at the same time.

The renewal of civil warfare in a China already stricken by war and famine gives at least some color to the statement recently attributed to General Smedley Butler, that civil order in China would be established only in a hundred years, when the bandit leaders were killed off and their sources of plunder exhausted. As another student of China has pointed out, her difficulties in establishing a government along modern lines,

arises partly from the fact that the military men, from whom her political leaders are chiefly recruited, belong to the lowest order in the Chinese social scale. A more specific explanation of the present situation is given by the correspondent Hallet Abend in the New York *Times* (May 25):

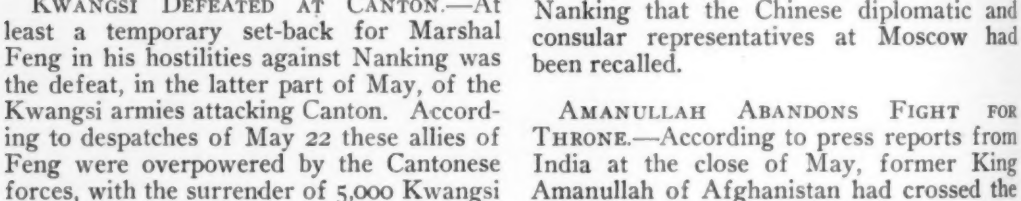
> The Nationalist failure to unite the country and establish a stable government despite the nominal adhesion to Nanking of all military leaders, flying the same flag from North Manchuria to the borders of Burma, is due to many factors, but the chief of these is the mutual distrust of all leaders of each other, coupled with widespread disappointment at the failure of Nanking to ameliorate conditions among the people, or to end alleged corruption or curb the ambitions of a small oligarchy heading the Nanking clique.
>
> This domestic failure of Nanking, critics say, is in sharp contrast with Nanking's really brilliant successes in the field of foreign affairs, including the part revision of treaties, attainment of tariff autonomy and achievement of formal recognition by foreign powers.
>
> The revulsion of feeling against the present Nanking leaders is best gauged by the fact that a year ago Feng Yu-hsiang, noted for his treacheries, was the most feared of all the military satraps, while today many provinces and cities look to him as their only possible deliverer from what they consider intolerable conditions.

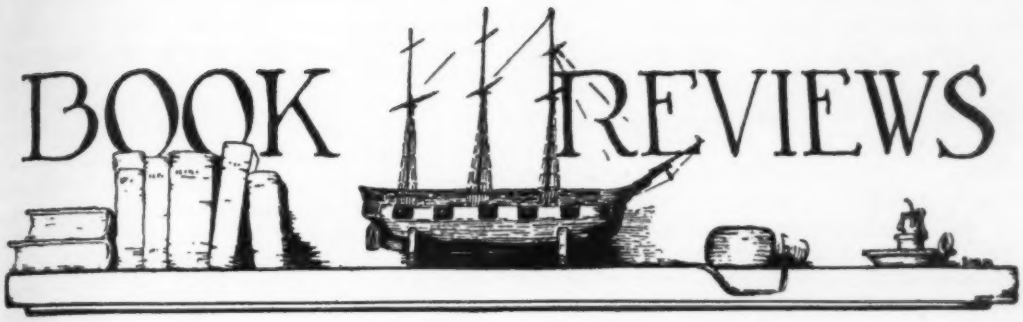
KWANGSI DEFEATED AT CANTON.—At least a temporary set-back for Marshal Feng in his hostilities against Nanking was the defeat, in the latter part of May, of the Kwangsi armies attacking Canton. According to despatches of May 22 these allies of Feng were overpowered by the Cantonese forces, with the surrender of 5,000 Kwangsi troops.

EXTRATERRITORIALITY DEMANDS.—On April 27 Foreign Minister Wang of the Nanking government sent identical notes to Ministers of the United States, Great Britain, France, and other nations concerned, urging abolition of extraterritorial privileges to foreigners at the earliest date possible. According to press statements at the time, the Chinese leaders were not particular as to whether this concession were made jointly or by individual states, so long as it were made soon. The Chinese note was published by the U. S. State Department on May 5, with announcement that Secretary Stimson would give it prompt and careful study, but without indication as to whether this government would modify its past policy of abandoning extraterritorial rights only by degrees, and in proportion as the Chinese government showed evidence of stability and progress.

RAIDS ON SOVIET CONSULATES.—During the latter part of May Manchurian officials, acting it was believed in coöperation with or under orders from the Nanking government, executed a series of raids on Soviet consulates at Harbin and other towns in Manchuria. It was reported that the purpose of the raids was to prove Soviet connivance in the revolutionary activities of Marshal Feng, and perhaps also to pave the way for seizure of the Chinese Eastern Railway. On June 1 it was reported from Nanking that the Chinese diplomatic and consular representatives at Moscow had been recalled.

AMANULLAH ABANDONS FIGHT FOR THRONE.—According to press reports from India at the close of May, former King Amanullah of Afghanistan had crossed the border from his own country, giving up his fight to recover his throne and deciding to take refuge in Europe. Evidence indicated that little success had attended his efforts to organize a military opposition against the bandit ruler Bacha Sahao, who drove both him and his brother from Kabul last winter.





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ABOUT AIRSHIPS. By E. F. Spanner. London. Published by the author (9 Billiter Square). 1929. 6s.

REVIEWED BY BROCKHOLST LIVINGSTON

To the man in the street, to whom he has addressed his book, Mr. Spanner may be convincing but, to any one whose knowledge of airships is even slightly broader, I am afraid he must appear only as unduly severe in his judgment of the airship's capabilities.

One is apt to be decidedly biased when he begins his book with the opinion that "they (rigid airships) are, have always been, and always will be utterly unable to justify themselves for either military, naval, or commercial purposes." As a personal opinion we may let it stand, but as propaganda against the further construction of dirigibles, it must be questioned. The rigid airship *has* justified itself on individual occasions, and with modern developments, the chances of further successes are certainly in its favor.

It is not my wish to criticize Mr. Spanner's conclusions. However, just a few of his points may be briefly discussed. His worry as to the "gold-beater's skins," may be set at rest since the United States Navy has found a substitute for this valuable fabric. His use of diagrams of the *Mauretania* to describe the antics of *R-34* is ill-advised, as they prove nothing. I should not want an ocean liner to bank and circle into its dock as does the cross-channel plane to its landing at Croydon, and yet, notwithstanding that momentary upset, plane services are commercial successes. And, personally, after experiencing both modes of travel, I much prefer the dirigible, for the convenience and comfort are greater, the noise negligible in comparison, and the remembrance of hot and tasty meals cooked aloft will always remain with me. There are inconveniences, many of them, but the rigid airship has far greater passenger-carrying possibilities than Mr. Spanner is willing to admit.

One must agree that stability with a movable live load is liable to be poor. While it is usual (on naval airships) to be assigned "landing stations," once the ship is in the air, freedom of movement is given to passengers within a restricted space. This may possibly be a source of trouble in passenger-carrying ships.

Far from being a difficult feat, mooring an airship at night is quite simple. I have landed after dark with an ease which would make many liners envious. Airships may also "lie to," as did the *Graf Zeppelin* when it repaired its fin on its trans-Atlantic trip. This ability is one of the points in favor of the dirigible as an observation craft.

Mr. Spanner mainly questions the wisdom of building *R-100* and *R-101* as passenger-carrying airships. I believe Great Britain is right in developing the dirigible—as are all countries—and Mr. Spanner must obtain more convincing facts before we act upon his recommendations to cease future construction.

THE CONFEDERATE PRIVATEERS

By William Morrison Robinson, Jr. New Haven: Yale University Press. 1928. $4.00.

REVIEWED BY REAR ADMIRAL ELLIOT SNOW (CC), U. S. NAVY

The Confederate Privateers, as the title clearly indicates, is a chronicle of one phase of the naval operations carried on during the War between the States. It is written from a Southern point of view, and at the outset the author, Mr. William Morrison Robinson, Jr., critically reviews the scant references made by previous writers to Southern privateers.

Concerning the point of view held by the author in the critical biography with which he opens his book, he says: "If the writer has seemed to be only adversely critical, it has been simply to show that there is no real bibliography on those last privateers in the world's history."

In his researches, the author found that the neglect of the deeds of the Confederate privateers was general and cites, in support of this finding, the meager references made to the privateering ventures made in aid of the Southern cause in the writings of Stark[1], LaMache[2], Maclay[3], Scharf[4], Greely[5], Soley[6], and Krafft and Norris[7].

The Southern point of view of the author is best shown by quoting a part of his conclusion, which forms the last chapter:

> The War of Secession was a revolution, mainly on the side of the Union. The South stood for the Constitution as understood on March 4, 1789; for the conservation of the social order which existed at the birth of the states; for the preservation of the immemorial rights of the individual. . . . . The overthrow of these principles and the establishment of a new conception of Federal Government by the Republican Administration of 1861-1865, were the beginnings of a revolution, which, through a long course of interpretations and amendments to the Constitution, has transformed the United States Government from a simple republican federation into a complex bureaucratic paternalism.

[1] *The Abolition of Privateering and the Declaration of Paris,* Columbia University Press, 1897.
[2] *La Guerre de Course,* 1901.
[3] *The History of American Privateers,* D. Appleton & Co., 1899.
[4] *History of the Confederate States Navy,* Roger Sherwood, 1887.
[5] *The American Conflict,* Case & Co., 1865-7.
[6] *The Blockade and the Cruisers,* Scribner's, 1883.
[7] *Sea Power in American History,* The Century Co., 1920.

"How the Confederacy Launched Privateering on the Seas," "The Response to the Lure of Sea Roving," and the beginning of privateering in the city of New Orleans—a city almost wholly French in its traditions, culture, and racial stock, constitute the subject matter of the first three chapters.

In part, the remainder of the book is given over to accounts of the careers of individual vessels, like "The Brief and Ill-Fated Cruise of the *Savannah,*" which a little more than three weeks after she first sailed (June 2, 1861) was captured and towed into New York; "The Jolly Cruise of the *Jefferson Davis,*" a smart clipper built in Long Island as the *Virginia* in 1856; "The Jaunty Little *Dixie,*" a wisp of another privateer hailing from Charleston, which after a cruise of about four weeks was chased into her home port and there abandoned her career; "The Successful Career of the *Sallie*"; of "The *Petrel,* the *Beauregard,* and the *Rattlesnake,* privateers which unluckily measured arms with men-of-war," and "The Dramatic Capture of the *St. Nicholas.*" The recital of the career of the *St. Nicholas* is a bit of very interesting narrative (of which there is too little in the book to make it attractive). "The prizes and amount of merchandise captured by the *St. Nicholas* have no parallel since the days of the *Saucy Jack,* one of Charleston's most successful privateers of 1812."

The chapters devoted to prize proceedings "In the Court of Admiralty of the Confederate States of America for South Carolina"; "The Trial of the 'Pirates'" (as the members of the crew of the *Savannah* were unfortunately at first termed, and at last conceded not to have been); "Certain Adventures More or Less Private" and "Some Reprisals without Letters" are principally of interest to students of admiralty and international law.

Here and there the author touches upon technical items, of interest to those whose bent lies in material directions; for instance, the successful introduction into naval warfare of ironclads, of submarines, and of steam-driven torpedo boats called "Davids." They took their name, as did the monitors, from the first of their class to be constructed.

The original *David* is credited by the author to the private enterprise of Theodore Stoney of Charleston, S.C. The little

"Davids," it might have been added appropriately, were designed by Dr. St. Julien Ravenel, and were built at his plantation "Stoney Landing," on Cooper River. Mr. Theodore Stoney furnished the money; General Beauregard gave an old boiler, and Mr. David C. Ebaugh arranged the machinery.

This history of the Confederate privateers, though it deals with a most unfortunate period in the march of progress of the United States, and may even now arouse bitter thoughts in the hearts of some, deserved to be written. As here presented, after very evident thorough research, it forms a very valuable addition to one phase of the influence of sea power on the destiny of the United States.

ELEMENTARY DIFFERENTIAL EQUATIONS, by Dr. T. C. Fry, of the Bell Telephone Laboratories, Inc. New York: D. Van Nostrand Company, Inc. 1929. $2.50.

REVIEWED BY PROFESSOR ALEXANDER DILLINGHAM, U. S. NAVAL ACADEMY

Those who had the good fortune to read Dr. Fry's *Probability and its Engineering Uses*, have another treat in store for them in his latest book, *Elementary Differential Equations*. Dr. Fry has a mission, and he is executing it with admirable skill. He is writing mathematics, primarily for engineers, in a style that is vigorous and convincing, and with a wealth of illustration that has real meaning to his clientele. It is no easy job to take the generalized and rather abstract results of the academic theory of differential equations and make them real and useable in a physical sense, and at the same time retain enough rigor to make them highly plausible. But this is precisely what he has done. The book is unique in its aims. The author's distinction between the "classroom solution" that satisfied the mathematician, and the "practical solution" that the engineer must get, is kept in the mind of the reader throughout. It is the keynote of the book.

The exposition is clear, convincing, and never complicated with irrelevant details. The author knows what he wants to say, and furthermore, he knows how to say it so that the issue is never in doubt. He is writing for the engineer and scientist, and the "bag of tricks" that he continually dips into for a tool to use in getting the practical solution of a problem, contains nothing but what would appeal to the engineer. On the other hand, the more abstract mathematician cannot fail to read the book with pleasure and profit, and if he ever had doubts before, he is forced to agree with the author when he says (p. 129) "Mathematical results have an almost annoyingly monotonous habit of being sensible."

The book contains many good problems and, what is better, many new ones which no doubt will soon begin to appear in the "usual type" of new book on the subject. The author uses a new way of arousing the interest of the student in solving problems, when (prob. 5, p. 145) he appeals to our universal desire to emulate a diety.

And now for the reverse of the picture for, of course, the reviewer must find *some* fault with the book. But this is difficult. The author clearly says in his preface that the book is intended for students of engineering and its allied sciences. So, if the reviewer should say that he thought the book unsuitable for arts students, he would have to admit that the fault was with the arts students, and not with the book. No, the book is all right, but the student, to profit by it, must be prepared for it with a good, broad knowledge of physics, plus a nimble and observing mind. The author very gracefully admits this in his footnote on page 75, where he says, "The solution of differential equations is no fit occupation for the obtuse."

THE SAILOR'S POCKETBOOK by Admiral Sir F. C. D. Bedford, R.N., G.C.B., revised and enlarged under the direction of Admiral Sir Reginald G. O. Tupper, R.N., K.C.B., C.V.O., and edited by Captain D. Fulton, R.N. Tenth Edition, Glasgow: Brown, Son & Ferguson, Ltd. 7/6.

This book is a collection of practical rules, notes and tables prepared for the use of the Royal Navy, merchant navy, and yachtsmen. It contains in handy form much useful information and is of particular value to the merchant marine and yachtsmen. While some of it pertains particularly to British installations, in the main its subject matter is of value to all seagoing personnel.

The subjects covered are "Flags and Signals," "Compasses," "Pilotage and Navigation," "Boats and their Management," "First Aid and Cookery," "Money and Measure Tables," "Docks at Home and Abroad," "Steam and Internal-Combustion Engines and Marine Engineering Installations," "Electricity and Magnetism," and "Radio."

The author, apparently after consulting many authorities and reviewing books on the subject, combined the results of his investigation with his own experience to produce this book. The subjects are treated pertinently and concisely. All extraneous matter has been eliminated and only essential facts are given, but in such a way as to be clear to the reader.

The book should be of interest to anyone who is interested in the sea or what seagoing men have to know or do. It is small, well illustrated and, containing as it does so much and varied information, keeps at hand in one volume much that is needed. It does away with the necessity for several books about the different subjects treated and for this reason should be of value to small boats where one book is all that they would desire to carry.

W. S. F.

THE CHINESE REVOLUTION—1926-27. By H. Owen Chapman. London: Constable and Company. 1928. 12s.

REVIEWED BY BROCKHOLST LIVINGSTON

There is much in this book to interest anyone who is concerned with the ultimate fate of China. It is a pity it is limited to such a short period of the revolution for so much has taken place since its writing. However, as the author states in his preface:

> Its (the revolution's) fate is still in doubt as this book goes to press; but there are few lovers of the country, Chinese or foreign, even among those who have suffered most at the hands of the revolution, who do not look eagerly for the day when it will vindicate itself by establishing a united, well-governed and independent China.

At the moment this review is being written, Chiang Kai Shek, as predicted, has emerged from his retreat and again taken the field. The outcome no one can predict, for Chinese generals with their varying sympathies are difficult to understand.

There is much to ponder on in Dr. Chapman's remarks on America's share of Chinese hatred. He writes:

> In a few of the speeches (for propaganda), and in the newspapers, the United States had its share of vituperation (along with Britain), especially after the Nanking incident, but this was in a more restrained and reproachful tone as a man might expostulate with a friend who had sadly disappointed and grieved him.

Even granting that this may be a personal opinion, America will do well to continue her policy of friendliness with China even, I venture to suggest, at the price sometimes of her pride. In the heat of revolution, it must be remembered, much is done which would ordinarily never occur.

In a section which he has entitled "The Silent Victory of the Foreign Navies," the author describes the foreign warships, "watchful, ever ready, force and striking power personified, yet never striking." And yet there are those who berate the so-called "gunboat policy." It is force, ever ready and yet not striking, which preserves the lives of the majority of the foreign population in the eventful days through which China is passing.

Japan's intervention in Manchuria is discussed in some detail, being concluded with the subtle statement:

> It should be noted that, according to Japanese interpretation, to turn the course of a civil war by open threat of formidable military force transported into Chinese territory appears not to be incompatible with "absolute non-interference in China's domestic affairs."

The Communist period of the revolution is termed "a period of momentous significance on the one hand for the future development of China, and on the other as the only indication yet given to the world as to what may be expected from the Third Internationale or Russia when its activities secure free play in another great nation."

In Dr. Chapman's belief, the efforts of foreign nations to extend their territory into China are doomed to failure. The chief protagonist of a policy of sovereignty for China "is the United States, proud of her own refusal to seek special privileges, and determined not to acquiesce in any other nation doing so: hence her initiation of the Four-Power Consortium.

The lack of capable men of disinterestedness, integrity, and loyalty, to carry China on her way to better days is impressed, and it is recalled that Sun Yat Sen found the

same lack when he had successfully managed the Revolution of 1911. The author continues:

> But there is no room for doubt that the Nationalist Party in China, though encumbered by many self-seekers and opportunists, and most seriously deficient in political experience and judgment, has nevertheless the interests and progress of the government at heart; and for this reason the prospects of its accession to power may be awaited in the confidence that, as in the history of other countries so here also, the responsibilities of office will inevitably modify a great deal that is now unreasonable, and teach in the hard school of experience the needed lessons of legislative and administrative wisdom.

Reading through the pages of this book brings out forcibly the trials China has gone through for independence and our final thought can only be agreement with the writer that:

> China is alive and awake. It is the rising of the sap; and the spring will blossom into summer . . . . that it will live, that it will develop and progress whatever fortune it may meet, this is certain.

PAPERS OF ISAAC HULL. Edited by Gardner Weld Allen. The Boston Athenaeum, 1929. 341 pages.

Reviewed by Professor Allan Westcott, U. S. Naval Academy

No extended biography of Commodore Hull has ever been written, and the present volume does not altogether fill this need, for though written as a connected narrative, and presenting considerable material from out-of-the-way sources, it gives only the first thirty-five pages of the most distinguished part of Hull's career—his wartime service up to the close of the War of 1812. Rather, as the title indicates, the book is a selection from a great mass of Hull papers, deposited by relatives with the Boston Athenaeum in 1924, the most important of which, according to the editor, are the log books of Hull's flagship *United States* when he commanded on the Pacific station, 1824-27, and logs and letter books of his flagship *Ohio* when he commanded in the Mediterranean, 1838-41.

The published extracts from these sources are of interest chiefly as giving a true picture of everyday life in the old Navy, and the trials of a commander in chief during a three-year, distant cruise. Problems of discipline, health, and sanitation, correspondence arising from trouble with people on shore, a belated impressment dispute with the British, measures of preparation necessitated by the very real danger of war with England in 1841—such are the matters dealt with. Not infrequently the final outcome of these affairs is not revealed in the papers, and the reader is left tantalizingly "up in the air," wishing (and this is perhaps the only criticism of the very able editing) that further light had been sought, where it could surely have been found, in the "Captain's Letters" and other official correspondence in the Navy Department Library.

There are glimpses of many well-known naval characters. "Mad Jack" Percival appears as commander of the sloop *Cyane*, with a crew which he has "no hesitation in saying is without exception the most inferior and indifferent ever attached to a vessel of this class which ever left the United States." Apprehending that his commander in chief suspects him of a "litigous disposition," Percival writes to Hull at great length, expressing his personal devotion, but also his intention to "state facts and opinions as they bear on my mind without consulting the opinions or wishes of anyone —were I not to do so, whatever the opinions might be, they would not be mine."

Lieutenant—later Rear Admiral—S. F. Du Pont also figures frequently, in characteristically assertive rôles. It appears that there were constant complaints in the *Ohio* about the "suffocating closeness" of the junior officers' quarters on the orlop deck. Offered temporary space elsewhere, Lieutenant Du Pont respectfully declines to change, preferring to remain "where the Navy Department has placed me, so long as my health will endure it, rather than occupy quarters which I deem unfit for an officer holding the third rank in the Navy." Again, on the occasion of a riotous conflict between officers and citizens at a Port Mahon masked ball, the tall and handsome Du Pont is an active participant, and is most insistent later that the affront shall not be passed over lightly, He requests Hull, in case he should take no further action, to forward his (Du Pont's) report to the Navy Department, and "a copy of the whole correspondence to the Senators and Representatives from my state, as well as those of the other officers concerned, that they may in conjunction with the Navy and State Departments seek through our Minister at Madrid. . . . . that

reparation which I humbly submit the case loudly calls for."

Clearest of the characters brought out in the book is that of Commodore Hull himself, "easy and prepossessing in his manners, but accustomed to face 'the battle and the breeze'," a typical old sea dog, "not pretending to much science," but, in Farragut's words, "as able a seaman as ever sailed a ship."

SEA SLANG

A Dictionary of the Old-Timers' Expressions and Epithets. By Frank C. Bowen, London. Sampson Low, Marston and Co. Ltd. (Illustrated) 3/6.

REVIEWED BY LIEUTENANT A. R. McCRACKEN, U. S. NAVY

Inasmuch as accurate information concerning the lives and habits of the old-time sailor-man is becoming increasingly difficult to obtain, Frank C. Bowen's *Sea Slang* will be welcomed by those who regard the early days of seafaring with interest and affection.

Graduates of the Naval Academy will find in this book many definitions which would have been of inestimable value to them during their "plebedom." In fact, the definition of a "timmynoggy" would have saved the writer much mental and some physical exertion.

Mr. Bowen sets forth his motives in the Introduction, quoted in part:

> There is no clearer indication of the changed condition at sea than the rapid disappearance of sea slang, the language which was the seaman's own and which was frequently almost unintelligible to the landsman. There was of course a good deal of profanity mixed with it in the old days, but even without that it was expressive, characteristic, and frequently poetical.
>
> When I enlisted as a seaman in the early days of the War the old hands who were with me used a slang that was practically the same as that of the late Victorian Navy and quite closely allied to the Navy of Nelson's day. When I went down to the Mediterranean fleet in 1927 I found that this language had practically disappeared. It occurred to me that unless the old slang were picked up and recorded immediately there was a danger that the older generation would have passed away entirely and with them their characteristic expressions. It was a reminder of the days when seamen were seamen, when efficiency was everything, and it struck me that it was well worth perpetuating.
>
> That is my excuse for this little book.

However, the following excerpts from the alphabetical arrangement of words and phrases will demonstrate that no excuse for the book is necessary.

My eye and Betty Martin.—An old naval expression signifying disbelief. The story is that a seaman wandered into a Roman Catholic church and afterwards told his messmates that they had only sung "My Eye and Betty Martin." (Mihi Beate Martine.)

Blood for Breakfast.—The admiral's or captain's temper, particularly in the morning.

Both sheets aft.—A sailor with his hands in his pockets.

Cherry tree class.—The British battleships, *Nelson and Rodney*, because they were cut down by Washington. (From 45,000 to 35,000 tons.)

Dog-barking navigation.—The American blue waterman's contempt for coastal navigators who were said to determine their position by the barking of the dogs on the farms that they passed.

Get to windward of a person.—To get the better of him.

Judies—The old sailing ship man's usual name for women.

Schooner on the rocks.—A cooked joint surrounded by potatoes.

Whistling psalms to the taffrail.—Giving good advice which is neither wanted nor followed.

X-Chaser.—A naval officer with high theoretical qualifications.

Among the terms which will be familiar to American Navy readers are: "Ash can," "bilger," "canned bill," "taking a caulk," "Charley Noble," "hit the beach," "lucky bag," "to spoon on," "field day."

Mr. Bowen states that he is

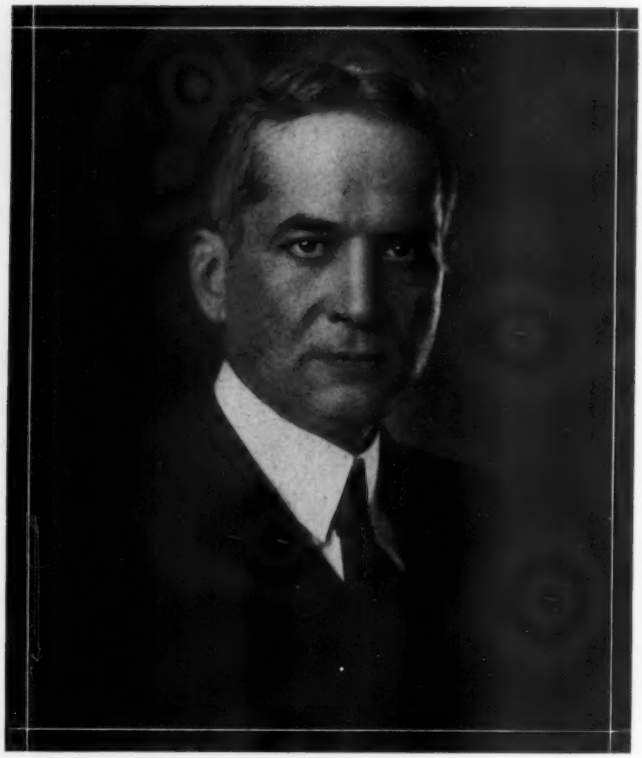
> perfectly well aware that it is not by any means complete and as yet only touches on the fringe of the subject. I hope, however, that this subject is of sufficient interest to the real old-timers to persuade them to let me have any phrases that come to their memory and that I have omitted. I am particularly anxious for a second edition, to get local or temporary uses of accepted phrases, many of which are extraordinarily interesting. The sailor's language is to a very great extent a monument to the memory of a magnificent breed that is unhappily dying.

Perhaps American readers can add to the list of U. S. Navy expressions for inclusion in the second edition of this unusual and entertaining book.

International Newsreel

THE CLASS OF '79, U.S.N.A., CARRIES ON IN THE CLASS OF '29.

Captain C. H. Harlow, U. S. Navy (Retired), representing the class of '79, presents a sword to the midshipman regimental commander, Class of '29, on the fiftieth anniversary of '79's graduation.



Distinguished Naval Academy Graduates in Civil Life

Richard Hallett Meredith Robinson

BORN Ravenna, Ohio, April 2, 1875, son of the late Judge George F. Robinson and Mary A. (Gillis) Robinson. Graduated from Western Reserve Academy 1892; U. S. Naval Academy, 1896. Postgraduate University of Glasgow, Scotland, 1896-98.

Served in the Navy as assistant naval constructor and naval constructor Cramp's Ship Yard, New York Navy Yard (in charge construction U. S. S. *Connecticut*); Bureau C. & R., 1898-1913. During the last eight years of naval service was assistant to chief constructor of the Navy, in charge of design and new construction.

Resigned February 15, 1913, to become managing director and general manager of The Lake Torpedo Boat Co., Bridgeport, Conn., and has been active in business since. Joined the Harriman interests June 1, 1917, as president of the Chester Shipbuilding Co., Ltd. and Merchant Shipbuilding Corporation—later consolidated. President United American Line, operating passenger and freight ships in intercoast and foreign trade from 1920 to 1926, at which time steamship operations were discontinued.

At present president of the Merchant-Sterling Corporation, (successor to Merchant Shipbuilding Corporation; president of the American Ship and Commerce Corporation; chairman of the board and president, Georgian Manganese Co., Ltd.; member Executive Committee W. A. Harriman and Co., Inc. (investment bankers); member of the Executive Committee American-Hawaiian Steamship Company; director of the Fidelity and Deposit Co. of Maryland, and of other corporations.

Married January 3, 1899, Rosalind Wood Smith of Pittsburgh, Pennsylvania. Resides at 555 Park Avenue, New York, and Tuxedo Park, New York.

SECRETARY'S NOTES

Tempest in a teapot

Captain Dudley Knox's article on "The Navy and Public Indoctrination," published in last month's issue of the PROCEEDINGS, seems to have aroused the ire of the little-navy group; which is strange in view of the fact that their propaganda set loose in the last session of the last Congress was so objectionable that it was a scandal in Washington; it was so bad that members of the Naval Committees spoke from public platforms denouncing it.

Readers of Captain Knox's article, those who were fair minded on the subject, realized that the article was designed to call attention to the value of educating the people of the country to the needs of an adequate national defense; that England has for centuries been preaching the gospel of adequate protection for her trade.

Captain Knox did not criticise the twenty million church members represented by the Federal Council of Churches of America for earnestly desiring peace; he objected to their being misinformed on the very vital subject of national defense and to their being used by mouthpieces who do not represent the national point of view. Heaven help this country if its citizens come to a state of mind that they are unwilling to fight even in defense of the honor of their families, as one of the best known of the pacifists gave as his attitude. Heaven help the church if it encourages such abjectness. Even a rabbit will protect its family.

In all the attacks upon Captain Knox for his frank article, no one has yet accused him of endeavoring to gain personal profit out of his support of the Navy, or of seeking advancement or glory. That is the usual line of attack on any naval officer who expresses an opinion.

Muzzling the other fellow's dog

With their usual logic, the spokesmen for the opponents of adequate national defense advocate the muzzling of naval officers, "they are paid to defend the country, not educate it." Are they afraid of the truth, or is it just a habit of intolerant people?

In this age, when one cannot pick up a paper, or go to a movie, or turn on the radio without being educated by government employees, from members of the Cabinet down, why should the Navy be discriminated against?

And as for the cry that naval officers are opposing the President's program for the reduction of armaments, that is all bunk. The President is committed to an adequate national defense by the platform on which he was elected. In fact, both major parties are committed to it. When the limits of navies are eventually set, we will find that the United States will still have to build to come up to our quota.

Neither party would have dared to announce a platform that did not provide for national defense, therefore let us recognize that we are to have national defense, and that

when it comes to the naval part of national defense, naval officers are better qualified to speak authoritatively on what is needed than people who shudder when they think of a man-of-war; that when limitations are set, naval officers should be consulted so that we are not deceived in what we are getting.

We have all seen that type of neighbor who wants everybody else's dog to be muzzled but not his own. He is not much use to the neighborhood.

"We Build a Navy"

The Naval Institute has just brought out a book by Lieutenant Commander H. H. Frost, U. S. Navy, on the struggles of this country to establish its rights to use the high seas, a century and a quarter ago. This book is entirely novel in that it discusses our early Navy, its activities, its ups and downs, in a manner that can be understood by the man on the street. It has enough action to merit the attention of any reader; it analyzes the actions of our early naval commanders from a new viewpoint which will interest naval readers.

Lieutenant Commander Frost's analysis of Jutland, the first authentic account which gave the moves of both fleets in that famous action, was published some years ago in the PROCEEDINGS. Readers of that series of articles will know what to expect in this book.

We suppose that we will again be accused of propaganda in publishing this book, but it is historically correct, and if history is propaganda, then we are guilty.

It is a good book, good reading to those who have an open mind, attractively bound, has thirty-three full-page illustrations in sepia tint, and will grace any book shelf.

We Build A Navy, by Lieutenant Commander H. H. Frost, U. S. Navy. Price $4.00 postpaid.

Address: Secretary-Treasurer, U. S. Naval Institute, Annapolis, Maryland.

"Aircraft Construction 1929"

Another book published by the Institute was prepared under the direction of Lieutenant Commander F. P. Thomas, U. S. Navy. This book actually came from the press in March, but due to the fact that it contained confidential matter which could not be released until July 1, publication notice was withheld until this time. This new book on *Aircraft Construction* presents aircraft in its more general features together with elements requisite to a fundamental understanding of the subject.

232 pages. Price $3.00 postpaid.

They still do it

In the New York *Sun* of May 27, it was stated that a police court justice had suspended sentence for larceny on condition that the guilty man join the Navy! The man had two previous convictions!

No doubt the justice wished to do the man a good turn, that he realized the Navy would make a man of him if anyone could. But the justice seems to have let his heart run away with him. If he had inquired, he would have found that the Navy only accepts men who have been vouched for by reputable citizens of the community in which they live, that there are waiting lists of excellent young men trying to join the Navy.

The Navy is a place for ambitious young men, for men of good reputation, for men sound physically and morally. The Navy cannot afford to lower its standards; it would not be fair to the men that are now in the service. The justice will have to find some other means of correcting his young man; maybe he can take him into his own home.

We keep growing

The membership of the Institute still maintains a healthy growth. But if we are to keep giving satisfaction, our members must keep up their interest. Nominations of friends who are interested in the objects of the Institute should be sent in whenever possible.

It has been hinted that the Institute is supported by the government, which, of course, is not the case. We are self-supporting and always have been. Naval officers for nearly sixty years have been using the pages of the PROCEEDINGS as a forum for the discussion of matters of interest to the Navy and other branches of the nautical profession.

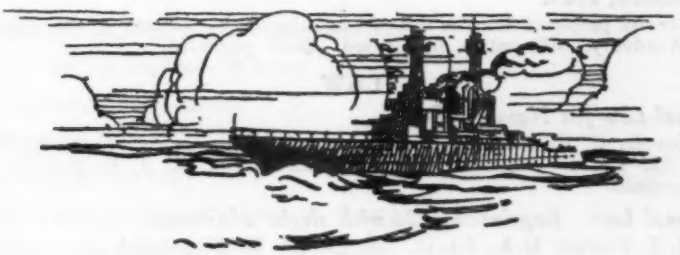
We have a fairly large civilian membership made up of the best people of the country, who are interested in the work of the Institute. The more members we have, the better will be the output.

So let's all get together and make the Institute and its PROCEEDINGS the most valuable organization and magazine of their kind.

Change in staff

Due to the receipt of orders to sea duty and consequent detachment from the Naval Academy, Commander Francis W. Rockwell, the editor of Professional Notes, and Lieutenant Commander Andrew C. McFall, the editor of Aviation Notes, resigned from the staff of the Naval Institute. We feel sure that the readers of the Naval Institute have appreciated the valuable information accumulated in the Professional Notes by these two officers and that we all regret their having to separate themselves from the editorial staff.

Lieutenant Commander Donald B. Beary will take up the duties of Commander Rockwell, while Lieutenant Commander DeWitt C. Ramsey will take up those of Lieutenant Commander McFall.



PUBLICATIONS
U. S. NAVAL INSTITUTE

PICTORIAL

Around the World with the Fleet, 1907-1909.

280 pages of the finest half-tone engravings showing pictures taken on this epic cruise. $3.50 postpaid.

BIOGRAPHY

Matthew Fontaine Maury.

By Charles L. Lewis, U. S. Naval Academy. Foreword by Commander Richard E. Byrd, U.S.N. A biography every American should read. 1927. $6.00 postpaid.

STRATEGY AND TACTICS

We Build a Navy, 1929.

By Lieutenant Commander H. H. Frost, U. S. Navy. A vivid and dramatic narrative of our early navy. XVI+501 pages, 33 illustrations. $4.00.

The Dardanelles Expedition. Second Edition, 1927.

By Captain W. D. Puleston, U.S.N. A critical study of this amphibious undertaking. 70 illustrations. Semi-flexible red buckram binding. $2.80 postpaid. ($2.25 to officers of the U. S. Army, Navy, Marine Corps, and Coast Guard, to members of the Institute, to all U. S. government departments, and to all who saw service in the Dardanelles Campaign.)

Five Years in Turkey.

By General Liman Von Sanders, Chief of the German Military Mission to Turkey. Translation by Colonel Carl Reichmann, U. S. Army (Retired). 340 pages, illustrations and three military maps. $3.50 postpaid.

NAVAL ORDNANCE

Exterior Ballistics, 1926.

For the instruction of midshipmen. By Lieutenant E. E. Herrmann, U. S. Navy, under the direction of the Head of Department of Ordnance and Gunnery. 322 pages with tables and figures. $6.00 postpaid.

Range and Ballistic Tables, 1926.

Prepared for use of midshipmen as an auxiliary companion volume for *Exterior Ballistics*, and contains tables required with the latter textbook. $4.70 postpaid.

Naval Ordnance, 1925.

A textbook prepared for the use of midshipmen by officers of the United States Naval Academy. 641 pages, illustrated. $6.00 postpaid.

LAW

International Law for Naval Officers.

By Comdr. C. C. Soule, U. S. Navy, and Lieut. Comdr. C. McCauley, U. S. Navy. 255 pages. Revised 1928 by Lieut. Comdr. C. J. Bright, U. S. Navy. $2.00 postpaid.

Constitutional Law. Reprinted 1924 with slight additions.

By H. J. Fenton, M.A., LL.D. 351 pages. $2.25 postpaid.

ELECTRICAL ENGINEERING

Robison's Manual of Radio Telegraphy and Telephony.

Eighth revised edition. By Captain S. C. Hooper, U. S. Navy. 780 pages, illustrated. 1928. $4.00 postpaid.

Storage Battery Manual, Including Principles of Storage Battery Construction and Design, 1920.

By Lieut. Comdr. Lucius C. Dunn, U. S. Navy. 400 pages. $5.00 postpaid.